Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.

VOL. LII. NEW YORK, SATURDAY, JULY 11, 1908. No. 2.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

JAMES H. McGRAW, President.
J. M. WAKEMAN, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.
CURTIS E. WHITTLESEY, Secretary and Treasurer.

239 WEST THIRTY-NINTH STREET, NEW YORK.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE.....590 Old Colony Building
CLEVELAND OFFICE.....1015 Schofield Building
PHILADELPHIA OFFICE.....Real Estate Trust Building
EUROPEAN OFFICE.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

United States, Cuba and Mexico.....per year, $3.00
Dominion of Canada.....4.50
Other Foreign Countries within the Postal Union.....6.00
25 shillings 25 marks 31 francs
Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies of issues prior to January, 1907, are kept on sale, except in bound volumes. Subscription orders being renewable at the end of the month indicated on the wrapper, the sending of remittances on or before that date will be much appreciated by the publishers.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

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Entered as second-class matter at the post office at New York, N. Y.

The circulation of ELECTRICAL WORLD *for 1907 was 951,250 copies, an average of 18,294 copies per week. Of this issue* 16,000 *copies are printed.*

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THE CONTRACTORS.

The National Electrical Contractors' Association convention to be held at Chicago next week will doubtless be one of the best that body has ever held in the seven years of its existence. The electrical contractor of the highest type is constantly assuming a more satisfactory and important position in the electrical industry because of a better understanding between the contractors as a commercial body and the central station companies. The spirit of co-operation which has grown up where the rights of each party have been respected by the other is an excellent thing for the advancement of the electrical business; and as it is so vital to progress we have given that subject considerable attention recently in these pages, as instanced by several articles elsewhere in this issue. Outside of a few of the largest cities the relationship of the central station and the contractor is of necessity closely knit, and this is a mutual advantage as well as cause for congratulation.

THE AGE OF WIRE.

The past 50 years have unquestionably been an "age of wire." Electricity has in some respects supplanted cable haulage, but while the present civilization lasts it looks as though the general uses of wire rope would increase and extend. Meantime electricity itself is causing a greater and greater demand for wire and cable and is broadly based upon their use. In this field of wire and cable manufacture, one or two great personalities have dominated, and at the very head stood John A. Roebling, altogether a genius and a great engineer. Few men have left a deeper imprint on their day and on industry generally than did he; and it is altogether fit and proper that in Trenton, where he called such vast manufacturing establishments into existence, employing thousands of people, there should have been set up last week a noble and dignified statue to his memory. The life work of Roebling was altogether beneficial to this country and to humanity, and the man himself was a fine spirit. The world would be better for more leaders like him.

THE TUNGSTEN AND THE CONTRACTOR.

The introduction of the tungsten lamp offers opportunities for probable business to the electrical contractor no less than to the central station company; in fact, the interests of the contractor and the central company in connection with these lamps are very similar. There is no reason why the two should not work in entire harmony. The contractor is chiefly interested, as is also the central station company, in getting tungsten lamps introduced in places where other forms of lighting have heretofore been used. There is much more chance for profitable business for the contractor in a complete new installation, including lamps and wiring, than there is in putting up a set of lamps and reflectors in existing sockets. The contractor will be called upon also from time to time to rectify the inefficient lighting installations from which the electric lighting company has had trouble and complaints, and frequently such modifications will include putting in new fixtures to replace old fixtures. The introduction of the tungsten lamp in existing installations

to replace less efficient lamps should give the contractor as well as the central station an opportunity to get the consumer to spend the money he saves for lighting in other ways. For example, if a merchant's store is well lighted at a lower expense than before, he will frequently be willing to go into window lighting, or sign lighting more extensively than he thought he could afford to do before he got the tungsten lamps. This means business for the contractor; it also means a better load factor for the central station company; so that both interests should work together in the same direction. In new installations which do not employ the tungsten lamp the contractor will be serving his customers' interests best by recommending arrangements which will make it possible to use the tungsten lamp later. The contractor who either through ignorance or through the desire to get the job of making expensive changes later does not advise the consumer properly or make the installation so that tungsten lamps can be easily used is likely to become discredited in the eyes of that consumer.

The Chicago Water Power Situation.

We have commented recently in our news columns on the peculiar situation in Chicago regarding the use of the electric power generated on the Chicago drainage canal which is being marketed by the trustees of the Sanitary District of Chicago. The Sanitary District has a plant at Lockport which, according to the recent report of the city electrician of Chicago, can deliver at Chicago about 19,000 electrical hp when fully completed. Of this, about 7000 hp can be used by the city of Chicago for its present electric street lighting. The trustees of the Sanitary District after having sold to the city enough power to operate its street lamps have been making contracts to sell a considerable amount of power to manufacturers and private consumers, so as to make the remaining plant capacity immediately earn revenue. In other words, the Sanitary District Trustees are seeking to establish a distributing system of considerable extent in Chicago, marketing power in competition with the Commonwealth Edison Company. The rates at which the Sanitary District is soliciting power are 15 per cent lower than the prevailing and reasonable rates of the central station company. Various obstructions have been thrown in the way of the attempt to build distributing lines. Leaving out of account all of the disagreeable charges and counter-charges which have been brought up by Chicago newspapers and others as to the reasons for this opposition to some of the movements of the Sanitary District Trustees in preparing to distribute this power, we wish to comment on one point which seems not to have been properly considered in this controversy. The tax payers of Chicago and vicinity have a valuable asset in the water power created by the great canal. This power should be utilized to the taxpayers' best advantage. The city's electric street lighting system needs to be greatly extended. If the marketing of a large amount of this power to private consumers at a very low rate is to mean that in the future the city electric lighting system cannot be extended as it should unless it uses steam power, it is certainly time to do a little serious broad-minded planning for the future. The electric lighting system of the city should be many times as large as it is now, and will undoubtedly grow very rapidly in the next 10 years if cheap power is available and if said cheap power has not been already sold to private consumers. It might be argued that as long as private consumers are paying for the power for the benefit of the tax payers, the tax payers can lose nothing by the transaction. This overlooks the fact that the great majority of private power consumers have what is technically known as a very poor load factor. That is, their maximum demand and the investment in plant consequent thereon is very high per dollar of revenue as compared with a city lighting load which is on 4000 hours per year. It would, therefore, be very unfortunate for the tax payers of Chicago if the capacity of the Sanitary District power plant were to be sold to private consumers under contracts which would not allow the same plant capacity to be used on street lighting and which would yield a lower net revenue per dollar invested in the plant than if the power were sold for city lighting purposes.

It would seem that the whole matter should be handled in a broad-minded way by a commission of experts looking well to the future needs of the city in electric street lighting (and possibly water pumping) and to the future development of water power along the canal. Such a commission could investigate thoroughly and determine as can no present public body whether the taxpayers' money should be spent in developing a duplicate competing distributing system for selling commercial power to private consumers or in a more extended application of electricity to street lighting and city water pumping.

It has been urged in this controversy that a distributing system over the entire city operated by the Sanitary District would by competition bring about lower rates to power consumers the city over. Considering the relatively small amount of power which can be developed on the drainage canal, as compared with Chicago's total demands, it would hardly seem likely that this could prove true in the long run, and the drainage canal power system would be loaded down with a heavy investment charge for a distributing system. In fact, it is well known that distribution in a large city is one of the heaviest items of central station investment. The old idea that rate regulation by competition is the only wise way is being discredited by those who have studied the subject. The present tendency is toward control of existing monopolies rather than toward the multiplication of public service companies. The controversy in Chicago has been carried out along entirely too narrow lines.

Electrical Shows.

In our first issue of June we published an article by Mr. E. B. Hillman, of Grand Rapids, Mich., calling attention to the possibility of extending the electrical show idea so as to include even the smallest towns, thus interesting the public in the smaller places in electrical matters and getting them familiar with practical electrical conveniences. Though the idea of electrical shows at which manufacturers are expected to make expensive exhibits can easily be overdone, it is nevertheless worth considering whether electrical shows on a small scale cannot be carried out in a great many cities, and even in the small towns. It is well to abandon once for all in this connection the idea that electrical manufacturers will send expensive exhibits accompanied by expensive men to a large number of shows. The burden would be too heavy to bear. There is already some protest from the manufacturers against multiplication of shows at which they must exhibit. If the electrical show idea is to be carried out as Mr. Hillman indicates, each show must be put through largely by local concerns immediate-

ly interested. The central-station company is, of course, the one most financially concerned. Along with it is the telephone company and electrical contractors and dealers in the town. As Mr. Hillman pointed out, the fact that the town is small and cannot afford a very large show need be no detriment, because the smaller the town, the smaller the exhibit necessary and the less expensive the preparation. If the scheme were adopted in a number of places manufacturers would no doubt organize matters in such a way as to loan exhibits to local dealers and central stations in rotation, the only expense to the manufacturer being the depreciation on the goods exhibited.

THE EXACT CIRCULAR CURRENT LOCUS OF THE INDUCTION MOTOR.

An article by Mr. K. J. Laurell dealing with the current locus of the induction motor, which appears on page 78 of this issue, is interesting and valuable both on account of the conclusions which the author derives and by reason of the methods employed by him. It is shown that, in so far as the motor can be treated as a transformer possessing a core of constant reluctivity and subjected to losses varying with the square of the flux, and having coils in which the losses vary with the square of the current, the primary current locus is a true circle. This conclusion differs from the one usually derived in that ordinarily a writer makes certain modifying assumptions which do not accord accurately with the initial assumptions, and obtains thereby a true circle on the basis of the introduced approximations. Mr. Laurell, however, shows that it is unnecessary to introduce the modifications because the current locus is a true circle if the initial assumptions relating to the "constants" of the motor are correct. His conclusions in this respect are identical with the results recorded by Mr. H. G. Specht in our issue for February 25, 1905.

Experiments on commercial induction motors have shown that the real primary current locus does not lie along the path assigned to it by the Behrend-Heyland circle diagram. Moreover, it fails to take the route selected for it by the various circle diagrams attributed to numerous other writers; in fact, the current locus, as found by test, is not a true circle. The article in this issue indicates that the departure of the actual locus from the circular path is due to a change in the "constants" of the motor circuits, which in reality vary greatly with the load on the machine. To just what extent the "exact" circular current locus will prove preferable to the "approximate" diagrams that are in common use it is impossible to state, but it seems probable that the latter diagram when drawn in conformity to test data and corrected according to the usual assumptions will, in most cases, be equally as reliable as the former when based on "constants" obtained from the same tests.

A prominent feature of the article in this issue is the method employed by the author. Briefly stated, when dealing with "series" circuits he has expressed the "constants" in ohms of resistance and reactance, and when treating "shunt" circuits the "constants" have been reduced to the equivalent conductance and susceptance expressed in mhos. The method involving the use of conductance and susceptance in shunted circuits is not new, but the application is somewhat unusual, because the author has found it unnecessary—in fact, undesirable—to resort to so-called "symbolic" expressions which, unfortunately, seem to have been heretofore almost inseparably associated with "conductance" and "susceptance." A more general use of the quantities "admittance," "conductance" and "susceptance" in place of "impedance," "resistance" and "reactance" is greatly to be desired, because shunted circuits are equally as frequently employed as series-connected circuits, and the average alternating-current problem deals with both kinds of circuits. The fact that "resistance" and "reactance" are in common use while "conductance" and "susceptance"—which in most problems would be equally as applicable and in many cases would prove far more convenient—are seldom seen, is attributable largely to their association with the "symbolic" method which appeals to mathematical physicists by reason of its mathematical simplicity, but has not been generally adopted by practising engineers, probably on account of the difficulty involved in interpreting the unduly-condensed expressions and transformations. The article of Mr. Laurell is valuable in demonstrating the great convenience of the use of the quantities "conductance" and "susceptance" in solving complex alternating-current problems by means of simple algebraic equations.

A PROPOSED STANDARD POWER RATING FOR AUTOMOBILES.

The question of a standard rating for automobiles was discussed a few weeks ago at a meeting of the mechanical branch of the Association of Licensed Automobile Manufacturers. At the present time, the horse-power of an automobile is largely left to the tender mercies of the salesman, because various formulas are in use for deriving the power of an automobile motor, and, ordinarily, no two of them agree. The branch favored a plan for determining the power from brake-tests at the fly-wheel, in conjunction with a particular formula, and referred to a mean piston speed of 1000 ft. per minute. It was also proposed to use a double rating, such as 20-24 hp, the 20 here representing the brake horse-power at the fly-wheel at 1000 ft.-per-min. piston speed, and the 24 representing the horse-power that could be attained under other and more favorable conditions. This plan would at least be definite, but the complexity of a dual rating seems likely to stand in the way of its adoption. A single standard rating under standard conditions is more likely to be generally adopted without difficulty. If a machine is able to develop steadily a greater power than the standard conditions permit, that fact is sure to make itself known. A brake horse-power rating seems to be the only proper basis, and the flywheel is a good standard place of reference. It seems likely that heavy wagon automobiles may develop commercially along the lines of the Heilmann locomotive; that is, with a gas engine on the chassis driving a direct-connected dynamo, and a pair of motors geared to the truck axle with electric series-parallel control. The advantages of this plan are that the speed-controlling mechanism is of a well-known reliable type, such as is used on electric cars, and the best speed of rotation in the gas engine for economy and effectiveness can be selected freely. The engine can be kept rotating at substantially constant speed at all running times, and the speed of the truck can be controlled entirely by electric means. It is doubtful whether this plan can be used with economy on ordinary touring cars, but when heavy trucks and drays have to be propelled, the extra weight of the dynamo is made up for not merely by the elimination of mechanical speed-changers, but also by the ease of control. Incidentally, the power of the vehicle can also be measured electrically with ease at any time.

Form of Retail Lighting Contract Approved in New York.

Representatives of the various electric-lighting companies in New York City and of the Public Service Commission, First District, have agreed upon a form of application and accompanying conditions for retail lighting contracts. The applicant is required to agree to the following conditions, except in the case of the Flatbush Gas Company and the New York & Queens Electric Light & Power Company, which charge rates of 12 cents instead of 10 cents:

"To be responsible for the service rendered hereunder, until three days after notice in writing is mailed or delivered to the company's office of the withdrawal of this application; to pay for such service monthly, or at such other times as the meter may be read, upon presentation of the bill; that the supply shall be measured at the service and by the meter provided by the company; that the rate shall be 10 cents a kw-hour; that no change shall be made in the equipment or in the type, size or number of lamps or other appliances connected therewith; that the current shall not be used except for the equipment scheduled by the company's inspectors; and that no other electric service shall be introduced or used in connection with the equipment supplied hereunder, without the previous written consent of the company."

The terms and conditions which are made a part of the application are as follows:

"1. The company shall bring its service wires to a point immediately within the vault or building line, and the applicant shall provide connections to that point.

"2. The company will furnish the meter and connecting service, which shall remain its property. The wiring equipment and appurtenances shall be furnished by the customer, who agrees to maintain them in the condition required by the insurance and municipal authorities having jurisdiction.

"3. The company shall retain title to all property furnished by it, and the customer shall be responsible for the safe keeping of the company on his premises. Should the supply of current be interrupted or be defective or fail by reason of accident, State or municipal interference, or other cause, the company shall not be liable therefor. Should interruption, defect or failure in service result from the company's negligence, the customer may terminate this agreement by written notice immediately delivered to the company.

"4. The company shall have the right of access to all its property installed on the premises supplied under this application at all reasonable times.

"5. The company may terminate this agreement on three days' written notice, and in case the applicant fails to comply with the conditions hereof may discontinue its service immediately and remove its property.

"6. The company shall not be liable for damage resulting from the use of electric current or the presence of the company's appliances on the applicant's premises.

"7. The company shall not be required to supply current until a reasonable time after all permits are granted and until this application is approved by the proper officers of the company. The applicant shall provide all permits (excepting street permits), or certificates, necessary to enable the company to properly connect the equipment to be supplied under this application."

Ohio Electric Light Convention.

Following is a list of papers scheduled to be read at the fourteenth annual convention of the Ohio Electric Light Association to be held at Hotel Victory, Put-in-Bay, Ohio, Aug. 25, 26 and 27 next: "Should Central Stations do Wiring?" "Why Municipal Ownership of Lighting Stations Has Not Been a Success;" "How Can We Best Increase Our Business?" "Experience with Luminous-Arc Lamps;" "Electric Signs and Other Special Uses of Electricity as an Adjunct to Profitable Station Work;" "Gas and Gasoline Competition and Best Ways to Meet It;" "Lecture on Illuminating Enginering;" "Best Ways and Means of Keeping Out and Getting Out Private Plants in Central-Station Territory;" "The Gas Engine in Central-Station Work;" "Gas-Producing Plants and Oil Engines and Their Results;" "Report Upon the Experience of a Large Number of Central-Station Men on the Tungsten Lamp." An elaborate program of entertainment has been prepared and a banquet for the guests will be given. Mr. D. L. Gaskill, Greenville, Ohio, is secretary.

One Year's Work of the Public Service Commission, First District, New York.

Chairman William R. Willcox, of the Public Service Commission, First District, has given out a statement in which he discusses the work that has been accomplished by the commission in the first year of its existence. The commission was established on July 1, 1907. Mr. Willcox says: "Considering the work which devolved upon the commission, I feel that a great deal of ground has been covered, and that everything which could be done has been done. A few of the most notable results are better express and local service in the subway, better and more frequent service on all the elevated roads and greatly increased service on all the most important surface lines. The car movement over the Brooklyn Bridge has been materially accelerated, owing to the action of the commission in insisting upon proper repairs to the rolling stock, and in regulating truck traffic so that vehicles may not delay the cars. Evils of financial mismanagement and consequent deterioration in operating service were disclosed by the commission's investigation into the Interborough-Metropolitan system, and the experience gained at this investigation has resulted in action by the commission toward preventing in the future the abuses of the past."

Many people may not be aware of the increase or improvement in the service rendered by a particular line because of the rapid increase in the number of passengers to be carried. Astonishing as it may seem at first thought, the number of rides on each business day on the street railroads in the entire city—elevated, surface and subway—is, on an average, something like 20,000 more than on the day previous. That makes an increase of about 6,000,000 rides a year.

Reports of the Wisconsin Railroad Commission.

Frequent references are made in these days to the hearings and decisions of the Railroad Commission of Wisconsin, and the subjects thus under controversy have been constantly noted in these pages. The body has been given broad jurisdiction over all the public service corporations of the state, and hence has had to deal with questions affecting rates of lighting and power companies. The various rulings and decisions have been brought together in one volume by Mr. J. M. Winterbotham, the secretary, accompanying another volume which gives the first annual report, for a period of December, 1906, to June, 1907, with statistics from June to June.

These volumes are of great interest and value, and the later reports must become even more so, since under the recent extension of its powers, the commission not only can determine what is reasonable in rate or service, but must value all properties, enforce uniform accounting, set up proper standards for measurement of quality and other conditions, hear complaints, test meters and keep itself advised of all extensions, new construction, etc. A great deal of work of this character, in valuing electric light properties, has already been done, for example, at Appleton, Ashland, Eau Claire, Fond du Lac, Green Bay, Hurley, Marinette, Menosha, Merrill, Milwaukee, Neenah, Racine, Sheboygan, Wanwatosa, Waupaca and West Allis. Similar work has also been done at Augustus, La Crosse, Madison, Manitowoc and Marinette.

The report includes data as to utility properties and a list of the different kinds or classes. Altogether it is a most interesting document.

Program of the National Electrical Contractors' Convention.

The annual convention of the National Electrical Contractors' Association will be held at the Auditorium Hotel, Chicago, July 15, 16 and 17. The opening session will be held at 10 a. m. on Wednesday, July 15, with a business session at 2 p. m. The men's banquet will take place at 7 p. m. in the large banquet hall of the Auditorium Annex, and the ladies' banquet in the small banquet hall of the Annex. The "open" and other sessions will be held in the assembly room on the sixth floor of the Auditorium. The program continues as follows:

Open session: Wednesday, July 15. Address of welcome, president of the Electrical Contractors' Association of Illinois.

Opening address, James R. Strong, president of the National Electrical Contractors' Association.

The Electrical Contractors' Opportunities in the Illuminating Field, Mr. George Loring.

The Relations Between the Underwriters and the Contractor, Mr. W. H. Merrill, Jr.

Open session: Thursday, July 16. Illuminating Engineering, Mr. J. R. Cravath.

The Relations Between the Lighting Company and the Contractor, Mr. Alexander Dow.

The National Electrical Contractors' Association, Mr. Seth B. Witherbee.

Business session, 2 p. m., business session, 7 p. m., ladies' theater party, 7 p. m., Rejuvenation of the Sons of Jove, time and place to be announced later.

July 17: All day outing at Michigan City, boat leaving Chicago at 9 a. m., and returning at 6 p. m. The fast steamer *Theodore Roosevelt* has been reserved for the occasion. There will also be a baseball game between the East and the West. Mr. G. M. Sanborn, of Indianapolis, has been nominated for president in 1908-9.

Meeting of the Indiana Municipal League.

The eighth annual meeting of the Municipal League of Indiana was held in Laporte, Ind., June 23 to 25 inclusive. Nearly 300 mayors, councilmen, attorneys and engineers attended the meeting. The principal topic, and the one creating the widest discussion, related to the municipal ownership and operation of public utility plants, such as electric light, gas, water, etc. The discussion was opened by the presentation of a paper by Mayor Schilling, of Richmond, Ind., who took strong grounds in favor of cities owning and operating their public service plants. He cited as an example the city of Richmond, which he claimed has a municipal electric light plant that has been in successful operation for a number of years, saving the people a goodly sum each year. A number of delegates present took part in the all day's discussion, the majority taking issue with Mayor Schilling, declaring that municipal ownership and operation was a failure and cited numerous instances where cities of Indiana had disposed of their municipal plants through receivership and otherwise and that other cities were likewise trying to rid themselves of the debt-creating burdens.

A. I. E. E. Section in Los Angeles.

A Los Angeles section of the American Institute of Electrical Engineers was organized under most auspicious circumstances the evening of June 16 at the Hotel Hayward, Los Angeles. Eighteen members and associates, together with about 50 invited electrical men, enjoyed an informal dinner, after which Mr. C. W. Koiner, manager of the Pasadena municipal plant, was elected temporary chairman, and Mr. J. E. McDonald, secretary of the joint pole committee, temporary secretary. By-laws for the government of the section were adopted and an executive committee of seven was elected. Officers are to be chosen from among the members of the executive committee by postal ballot. Those elected to the executive committee are: Messrs. C. A. Copeland, consulting engineer; C. W. Koiner, H. A. Lighthope, electrical engineer, Edison Electric Company; J. E. McDonald, T. E. Panter, electrical engineer with C. F. Scathergood; Edward Y. Porter, illuminating engineer; E. Woodbury, electrical engineer, Pacific Light & Power Company.

After the organization was completed a number of those present spoke briefly, the general sentiment being that a live and energetic section had been launched. Some 40 application blanks were taken by non-members present, nearly all of whom will become associates of the institute, many taking time by the forelock by filling out their applications at once, so that about 20 were forwarded to Secretary Pope within the week, and many more will go forward at once. There is reason to believe that the section will number at least 100 within the year, and as it will include some of the most progressive practical engineers in the country, and as California contains some of the most important engineering works to be found anywhere, the section should become a powerful factor in the advancement of electrical interests in the Southwest and the country at large. All members and associates south of Bakersfield are considered available as members of the Los Angeles section.

A Statue to John A. Roebling.

At Trenton, N. J., on June 30, a statue was unveiled of the late John A. Roebling, and the occasion was made a public holiday. One notable feature was the procession of 6000 employees of the Roebling works, who, accompanied by nine bands, marched to Calwalader Park, where the statue stands on a high knoll, and where some 15,000 people had assembled to witness the exercises. The dedicatory address was made by Mr. Henry B. Estabrook, general counsel of the Western Union Telegraph Company, whose daughter is the wife of Mr. Carl G. Roebling, a descendant of the founder, and now one of the managers of the great Trenton works. In his eloquent oration Mr. Estabrook recalled the career of the great engineer thus honored.

John A. Roebling was born at Mulhausen, an old walled town in Germany, which sent for this occasion a beautiful brass wreath in recognition of the honor thus paid to one of its sons. Mr. Roebling came to the United States in 1831, a young man of 25, well equipped for the battle of life, having been not only a student of engineering, but also one of the favorite pupils of the great philosopher, Hegel. At first Roebling took up farming with a number of German associates, but soon obtained employment as a canal engineer, and was not long in developing his wire rope, his method of suspension for cable bridges, and a great many inventions of this nature, leading up to the creation of such structures as the Wheeling bridge, the suspension bridge at Niagara Falls and Brooklyn Bridge. Incidental to the development of these structures came the organization of the great factory and industries at Trenton, N. J., where every process employed may be said to have been invented or improved by Roebling, and where a vast network of enterprises now stands as the result of his energy and genius. The Trenton works cover to-day 35 acres, are driven by some 10,000 hp of engines and boilers and employ 6000 hands, whose wages alone amount to about $4,000,000 a year, and the value of whose annual output is in excess of $20,000,000. The industry is carried on to-day with increasing efficiency and success by such men as Ferdinand W. Roebling, W. A. Roebling, Charles G. Roebling, of the second generation, as well as by F. W. Roebling, Jr., and Carl G. Roebling, who represent the third generation. Associated with this industrial enterprise has been the foundation of subsidiary factories, branch offices all over the world, and the new town of Roebling, which may be regarded as a suburb of Trenton.

The monument to Roebling is of bronze on a granite pedestal, and reaches a height of nearly 16 ft. from the ground. The statue was designed by William Couper, an American sculptor, and was cast by the Gorhams, at Providence. On the granite pedestal are bronze panels with inscriptions and reliefs showing the Brooklyn and Niagara bridges, etc. The monument in its entirety represents a cost of about $14,000, which was raised by the Roebling Monument Committee, whose work was thus brought to such a happy conclusion.

Annual Convention of the A. I. E. E.

The annual convention of the American Institute of Electrical Engineers, which was in progress at Atlantic City as our issue for last week was placed upon the press, proved thoroughly successful from many points of view. Many of the papers presented may well be considered as classics and they will frequently be referred to in the future. From the viewpoint of work accomplished, the keynote of the convention was harmony among the workers, which must be attributed to the exceptional executive ability of President Stott.

Our issue for July 4 contained a brief account of the two sessions held on Monday, June 29, and the opening session on Tuesday. Abstracts of the papers read at these meetings will be given in future issues.

The evening session on Tuesday was devoted to the presentation and discussion of papers relating to high-tension transmission. A notable paper by Mr. Ralph D. Mershon on "High-Voltage Measurements at Niagara" described the results of tests on the energy loss phenomena of high-voltage transmission systems. This paper was discussed by Mr. H. L. Doherty, Prof. Elihu Thomson, Dr. S. Sheldon, Mr. Henry Floy, Dr. C. P. Steinmetz, Messrs. P. H. Thomas, P. M. Lincoln, Carl Hering, C. F. Scott, P. N. Nunn and Dr. A. E. Kennelly. The great importance of the results recorded was recognized by all, the tests serving to confirm certain of the original observations made by Mr. Mershon at Telluride and the conclusions reached by Prof. Ryan from tests conducted at Cornell University, while throwing doubt on other observations and conclusions. A considerable portion of the discrepancy was attributed to the difference in the methods of interpreting the observations.

A paper by Mr. D. R. Scholes, entitled "Fundamental Considerations Governing the Design of Transmission-Line Structures," was read in abstract by Mr. Ralph D. Mershon. This paper, which dealt with the mechanical features of towers and spans in transmission systems, was discussed by Mr. N. J. Neal in a written communication. "The Testing of High-Voltage Line Insulators" was the subject of a paper read by Mr. C. E. Skinner, and discussed by Messrs. N. J. Neal, P. H. Thomas, Ralph D. Mershon, E. M. Hewlett, Dr. C. H. Sharp and Dr. C. P. Steinmetz. Abstracts of the above papers and discussions will appear in a subsequent issue.

During the session held on Wednesday morning five papers relating to alternating-current machinery and two papers dealing with generating stations were presented. Prof. Comfort A. Adams read a paper entitled "Voltage Ratio in Synchronous Converters, With Special Reference to the Split-Pole Converter." Applications of storage batteries to the regulation of alternating-current systems were described by Mr. J. Lester Woodbridge, special emphasis being placed on the split-pole converter. Mr. B. A. Behrend gave an outline of a new large generator for Niagara Falls. "Modern Developments in Single-Phase Generators" was the title of a paper by Mr. W. L. Waters. Mr. Jens Bache-Wiig presented a paper on "Application of Fractional-Pitch Windings to Alternating-Current Generators." Abstracts of these five papers and the discussion following their presentation are given elsewhere in this issue.

A paper by Mr. J. R. Bibbins described double-deck steam turbine generating stations. This paper was abstracted in our issue for July 4. "Working Results from Gas-Electric Power Plant. Report of 30-Day Test on Service Plant, Richmond Works, American Locomotive Company," was the title of a paper presented by Mr. J. R. Bibbins. An abstract of this paper will appear in a later issue.

During the afternoon session on Wednesday Mr. H. C. Specht read a paper dealing with the cascade operation of induction motors for multispeed service. This paper is given in abstract elsewhere in this issue. "From Steam to Electricity on a Single-Track Road" was the title of a paper by Prof. J. B. Whitehead. This paper was discussed by Messrs. W. I. Slichter, William McClellan, A. H. Babcock, A. W. Copley, W. L. Waters and S. N. Clarkson. A paper by Mr. G. B. Werner dealing with the determination of the economic location of substations in electric railways was discussed by Mr. C. J. Hopkins. "Conductor-Rail Measurements" was the title of a paper by Mr. S. B. Fortenbaugh. Abstracts of these papers will be printed in later issues of Electrical World.

The leading paper of the session on Thursday morning was entitled "The General Equations of the Electric Circuit" by Dr. C. P. Steinmetz. This paper gave an outline of the mathematical treatment of the phenomena of the electric circuit. Assuming that the resistance, inductance, shunted conductance, susceptance and capacity of the circuit are constant, equations were derived for expressing the phenomena that may ocur in the most general case. These equations are given by a sum of terms or groups containing trigonometrical and exponential functions of time and distance, and the difference between all of the phonemena which may occur in electric circuits merely result from different numerical values of the integration constants of this general equation.

In discussing this paper Prof. F. Bedell remarked that such a paper should be presented at one annual convention and discussed one or two years later. He expressed his appreciation of the value of the physical interpretation given by Dr. Steinmetz to each resulting mathematical equation, and explained the distribution of electric charge over a transmission circuit as analogous to the movement of a pressure disturbance along a rubber hose filled with water.

Prof. D. C. Jackson stated that the complex circuits, such as discussed by Dr. Steinmetz, are analogous to a vibrating string composed of sections having different physical characteristics of elasticity and mass. He expressed the opinion that the paper will be read for at least 10 years continuously.

In reply to questions by Prof. J. P. Jackson, Dr. Steinmetz said that he has not as yet discovered an exact mechanical analogue for showing transient phenomena in complex electric circuit.

The second paper of the morning session was also by Dr. Steinmetz, its title being "Primary Standard of Light." This paper was discussed by Dr. A. E. Kennelly, Dr. E. P. Hyde, Prof. W. S. Franklin, E. B. Rosa, H. S. Carhart, C. A. Perkins, Messrs. Carl Hering, J. B. Taylor and Dr. C. H. Sharp. It was suggested that the three-color method of obtaining a primary standard of light, as proposed by Dr. Steinmetz, should be given a thorough trial at the Bureau of Standards at Washington. The board of directors of the institute was requested to recommend that investigations be carried out at the bureau.

A paper by Mr. Carl Hering dealt with an imperfection in the usual statement of the fundamental law of electromagnetic induction. Written discussions were submitted by Dr. C. P. Steinmetz, Dr. A. E. Kennelly, Prof. Elihu Thomson, Prof. W. S. Franklin, Prof. W. P. Graham, Mr. P. H. Thomas and Mr. G. T. Hanchett.

A paper by Dr. Harold Pender described a minimum work method for the solution of alternating-current problems. The discussion on this paper was opened by Mr. P. H. Thomas, who remarked that considering the fact that numerous tabulated data are required for solving the problems, not much work is avoided by employing the method proposed. Prof. C. A. Adams stated that an objectionable feature of the method, especially for students, resides in the fact that it does not keep one closely in contact with physics, and hence it does not aid one in appreciating the significance of the equations. Abstracts of these papers will be given in a subsequent issue.

A paper by Mr. R. E. Hellmund on "Graphical Treatment of the Rotating Field" and one by Mr. Carl J. Fechheimer on "The Relative Proportions of Copper and Iron in Alternators" were presented by the authors. These papers are abstracted elsewhere in this issue.

The last session of the convention was held on Thursday afternoon, when three papers on educational topics were read. Mr. M. W. Alexander described a co-operative method of training engineers, according to which the student spends alternate periods at the college and in the factory. Mr. D. B. Rushmore and Mr. B. A. Behrend presented papers dealing with the relation between the manufacturing company and the technical

graduate. The papers were discussed by Prof. J. P. Jackson, Mr. P. H. Thomas, Prof. Morgan Brooks, Mr. R. W. Pope, Prof. H. H. Norris, Dr. C. P. Steinmetz, Prof. J. P. Jackson, Prof. C. A. Adams, Prof. A. F. Ganz, Messrs. C. F. Scott, J. R. Bibbins, G. S. Dunn and the authors. Abstracts of these papers and discussions will appear in a later issue.

Of more than ordinary interest was the special meeting on sections and branches, held on Wednesday evening, when Mr. Paul Spencer, chairman of the sections committee, presided. Experiences were related by Mr. D. B. Rushmore, Mr. J. Insull, Mr. C. F. Skinner, Mr. P. Spencer, Prof. H. D. Bates, Mr. H. R. King, Prof. J. P. Jackson, Prof. H. H. Norris, Prof. J. M. Bryant, Prof. D. C. Jackson, Mr. J. H. Finney, Mr. H. Goodwin, Prof. G. Wittig, Mr. J. M. Stevenson, Past-President Scott, President Stott and President-elect Ferguson.

RESOLUTIONS.

On motion of Prof. Elihu Thomson, seconded by Mr. William McClellan, the institute passed unanimously a resolution commending the action of the presidents of the engineering societies for the active part taken by them in suggesting the future policy of the government with reference to the conservation of our natural resources on the occasion of the recent convention of governors in Washington.

Dr. Samuel Sheldon, on behalf of the board of directors, presented to Past-president C. F. Scott a framed token of the appreciation of his three years of service as trustee and in connection with the building committee and joint committee of the engineering societies.

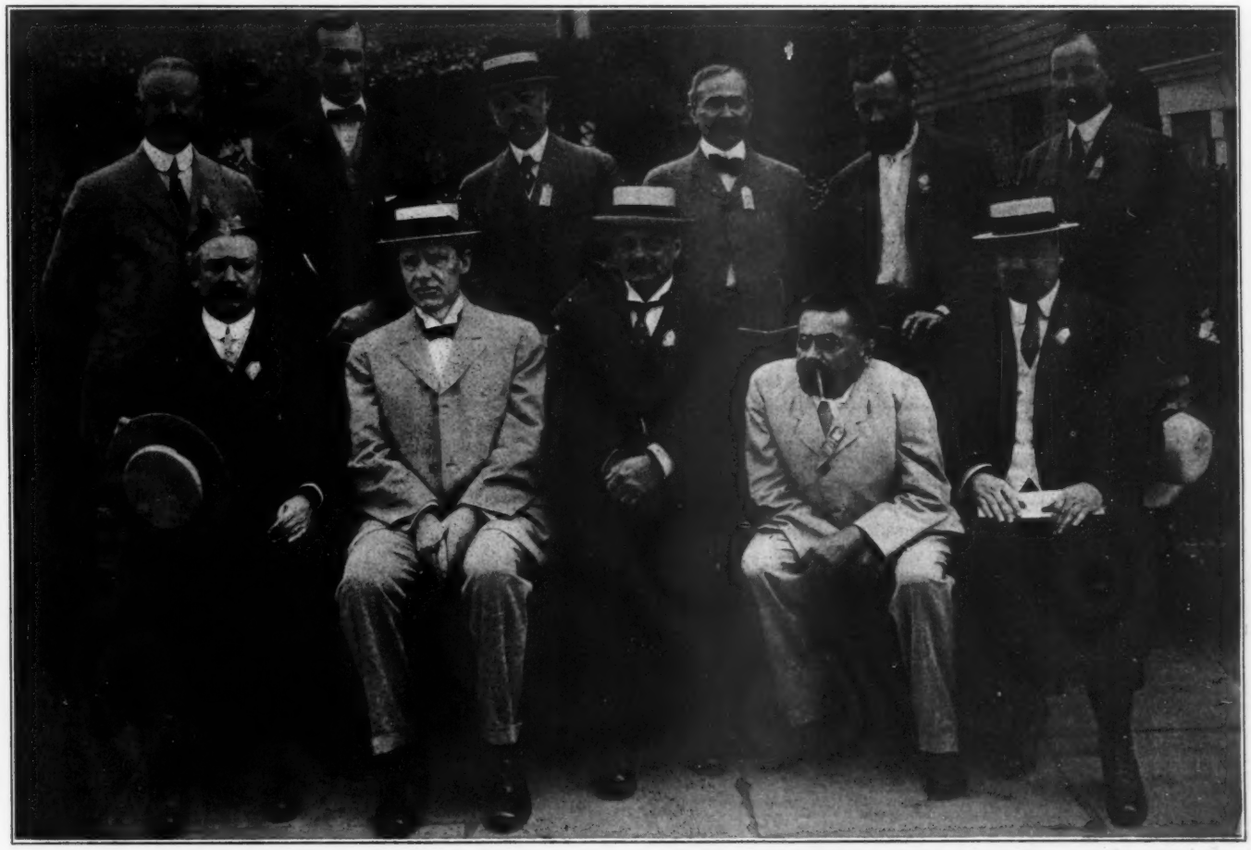
An expression of sympathy with Dr. F. A. C. Perrine in his illness at the Traymore which prevented him from attending the sessions was extended in the form of a resolution suggested by President Stott. Resolutions of appreciation were passed for the entertainment committee, the Philadelphia section and the manager of the Casino, which had been used for the reception and dance on Monday evening.

President Stott expressed his thanks to all of the committees for their hearty co-operation and support during the past year, especially to the meetings and papers committee upon whom the success of the institute from an engineering point of view so largely depends. He announced that Mr. A. H. Armstrong had been selected to succeed Mr. P. H. Thomas as chairman of this committee.

A touching tribute to the esteem in which the retiring president is held was given when Prof. J. P. Jackson asked for an expression of appreciation for the efficacy of the untiring efforts of President H. G. Stott. A resolution to this effect was passed unanimously amid applause so enthusiastic and prolonged that the president found difficulty in expressing his thanks.

The Philadelphia Section of the Institute were the hosts of the Convention, Atlantic City being within their territory. The committee comprised the following, nearly all of whom were present and were active under the direction of Mr. J. F. Stevens and Mr. W. C. L. Eglin in providing for the comfort and pleasure of the members: Messrs. Bartlett, Batt, Benoliel, Beyer, Biddle, Blizard, Buchanan, Buddy, Cheyney, Coles, Creagmile, Dallas, Devereux, Dodge, Denn, Evans, Francis, Garrison, Gherky, Green, Hamilton, Hering, Herman, Hewitt, Heywood, Hopkins, Hornor, Hough, Hunter, Hyde, Jackson, Janney, Jennings, Kelly, Jr., Klumpp, Leeds, Fafore, Lesley, Lupke, Kimber, McLaughlin, Northrup, Pike, Reynolds, Rowland, Schafer, Schick, Schreiber, Sharer, Smith, Snook, Spencer, Spencer, Stitzer, Stimpson, Stockwell, Temple, Van Staggen, Whitney, Woodbridge, Woodward, Lincoln, Loutey, Titzel, Nathan, Ashbridge, Brown, Steck, Williams, Kershner, Entz, Braddell.

Ferguson *Scott* *Martin* *Duncan* *Hering* *Kennelly*



Sheldon *Stott* *Thomson* *Steinmetz* *Lieb*

PAST PRESIDENTS, PRESIDENT AND PRESIDENT-ELECT, A. I. E. E., 1908.

The plan of entertainment was not an ambitious one, Atlantic City being itself a synonym for entertainment so that to provide anything extra would be a work of supererogation. The meeting opened on Monday with a reception and dance given in the Casino, next door to the Traymore. This was very largely attended and dancing was kept up until the small hours of the morning. On Tuesday afternoon, tea was served at the golf links, Mrs. Stott, Mrs. Thomas and Mrs. Day pouring tea on this occasion. During the afternoon several of the members participated in golf matches and the prizes in the putting contest for ladies were won in the following order: Mrs. Kern Dodge, Mrs. L. A. Ferguson, Mrs. Charles Stone, Miss Jane Morris Eglin, Mrs. Donohoe and Mrs. Waters. Tickets of admission were provided for the Steel Pier, Young's Pier and the new Million Dollar Pier, which were available to all members and their friends. Informal sailing parties were also organized by the committee during the week.

One of the most interesting social functions was the breakfast of the past presidents of the institute at the Traymore on Wednesday, July 1. This was presided over by Prof. Elihu Thomson, and there were present Messrs. Martin, Duncan, Kennelly, Hering, Lieb, Sheldon, Scott and Steinmetz. Mr. Stott, retiring president, and Mr. Ferguson, president-elect, were also present, and a most delightful reunion followed. During breakfast several institute topics were discussed and action was taken in regard to one or two matters for the general welfare. After breakfast the party were photographed opposite the hotel; an engraving of the protograph appears herewith.

Destruction of the Cazadero Station of the Portland Railway, Light & Power Company.

The Cazadero power plant of the Portland Railway, Light & Power Company, Portland, Ore., was completely wrecked early on the morning of June 21 by a mishap to the machinery. The governor on one of the water wheels stuck in some mysterious way, allowing a full head of water to rush through the turbine driving the generator, which straightway proceeded to speed up. When the attendant endeavored to shut the emergency gate, this was found to be jammed and inoperative. The generator was soon revolving at a terrific pace, which dislodged some of the pole pieces and threw the revolving-field structure out of balance, so that the entire generator burst asunder in a very short time.

The governor of the adjacent machine was struck by a piece

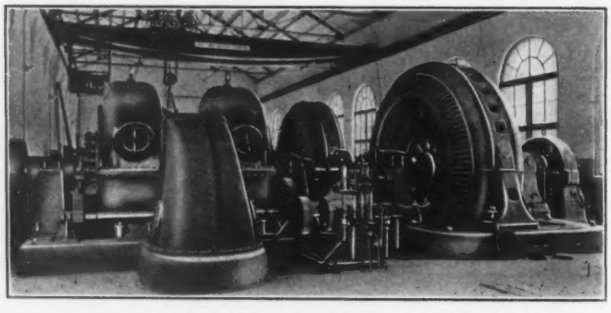


FIG. 1.—INTERIOR VIEW OF CAZADERO POWER PLANT.

of flying metal and rendered useless. As a consequence the gate flew wide open and the generator "ran away," meeting the fate of the first machine. Pieces of this second generator were hurled through the building and the remaining generator suffered destruction also. The complete demolition of the electrical generating apparatus was brought about in three minutes. The water wheels, from all reports, were undamaged save for the breaking of the shafts, and shortly after the accident were stopped from the head gates. One end of the station contained a temporary wooden floor and wooden roof for convenience in installing additional machinery. This end of the station was set afire by the wreckage which flew in that direction. The switchboard end of the station was undamaged. All of the 18-in. shafts were broken off and twisted, as shown in Fig. 2, which is a view of the wrecked station.

The Cazadero plant, which was described in our issue of April 11, 1908, was considered to be one of the finest water-power stations on the Pacific Coast. The water wheels operated under a head of 112 ft. and the three wrecked generators were rated at 2500 kw each; their destruction was complete, not even a pillow block remaining which might be of service in reconstruction. The high-tension transformer equipment connect-

FIG. 2.—VIEW OF WRECKED PLANT.

ing the Cazadero station with the other stations of the Portland system is located on the opposite bank of the Clackmas River. The high-tension lines are controlled by closed-circuit switches which energized from the excited busbars. As soon as the accident occurred the 33,000-volt lines were automatically disconnected from the system so that no damage to the substation resulted. The station was placed in operation early in February, 1907, and is the largest in the Portland system. Repair work has already been started, and an attempt has been made to obtain generators already built and not immediately required by those for whom they were built. Prior to the destruction of the station the question of installing 60-cycle apparatus in preference to 33-cycle apparatus for extensions was seriously considered, and 60-cycle apparatus may be installed to replace the wrecked generators, but this has not as yet been decided. There was no interruption to the service resulting from the destruction of the Cazadero station, for at the time of the accident, about 6 o'clock in the morning, very few lamps were in use and few cars were running. The apparatus of the auxiliary steam station, described in our issue of April 18, was immediately brought into service, and is now running overloaded to take care of the load. The company has six steam stations which are used chiefly as auxiliaries to the water-power plants. These stations have been used very little during the past six months and, as indicated in the article mentioned, have been thoroughly overhauled and are in good condition.

First Commencement at Carnegie Technical Schools.

The Carnegie Technical Schools, at Pittsburg, held their first commencement on June 17, and special interest attached itself to the occasion in consequence. In the two schools of Applied Science and Applied Design, a class of 60 men were graduated, of whom 21 were awarded diplomas in the course of electrical engineering. A present student enrollment of over 2000 indicates what the growth of this institution has been since its inception.

Dr. Robert S. Woodward, president of the Carnegie Institution of Washington, was the commencement speaker, his subject being "Our Educational Opportunities and How to Use Them." In the course of his address, Dr. Woodward said that: "Commencement Day should mark the beginning rather than the end of a course of study; for whether the student realize it or not, he is about to be enrolled in the 'University of the

Universe,' from which there are no graduates. Education is a process which begins in infancy and should continue in the normal individual without interruption to advanced age. There should be no such thing as 'finishing' or 'completing' one's education. This should be a lifelong process, and one's intellectual growth should cease only with the coming of vital decay." He cautioned students against mistaking the symbols for the substance of learning, and against the fallacy of supposing that to be successful, or even great in life, one needs to possess rare endowments, or what is often vaguely called genius. The greatest achievements do not, in general, come suddenly or in a spectacular way. They are the fruits rather of painstaking and persistent industry quietly and unostentatiously applied.

Co-operative Engineering Courses at University of Cincinnati.

A paper read by Dean Herman Scheneider, of the College of Engineering, University of Cincinnati, before the Detroit meeting of the Society for the Promotion of Engineering Education, on June 27, set forth a few of the principal features developed during the two years of operation of the co-operative courses at the University.

The co-operative courses as now operated contemplate that a student shall work alternate weeks in a mechanical, chemical or electrical factory in Cincinnati and at the College of Engineering of the University of Cincinnati. The class is divided into two sections, which alternate with each other during the collegiate year. The students are paid for shop work on a scale of wages which begins at 10 cents per hour and increases at the rate of one cent per hour every six months, making the total earnings of the course about $1800. The course requires six years, and is just as thorough, broad and cultured as the four-year course and has the same entrance requirements.

When the course was begun two years ago, about 30 manufacturers agreed to make the experiment. The plan worked with the utmost smoothness in all the co-operating shops excepting one. This shop has its main office in another city, and during the two years of the co-operation there have been three changes in the management of the local shop. With this exception, however, manufacturers are entirely satisfied that the system is a thorough success.

The only additional expense connected with the co-operative system relates to the repetition of each lecture. On the other hand, there is a large measure of economy in the co-operative course by reason of the fact that the University is not required to equip, maintain and supervise practice shops. The manufacturing shops of Cincinnati are the practice shops of the University, and the student, instead of paying for instruction, receives much superior training in the factories and is paid for his work. Engineering laboratories can be cut down in equipment to a certain extent without any loss of efficacy, for the testing-rooms and engine-rooms of the commercial shops become in a measure the engineering laboratories.

The fundamental principle underlying this course is based upon the rational assumption that the proper way, and the only way, for a young man to learn the practical side of his profession, together with business details and an intimate knowledge of the labor problem, is by working as a regular employee in a commercial shop; moreover, the only place where he can learn properly the scientific and the cultural subjects is at a school under trained teachers. This further implies that the school work and the practical work should, as far as possible, go hand in hand,

As showing the relative efficacy of instruction in the four-year and the co-operative courses, it may be stated that in chemistry, for instance, 90 per cent of the co-operative students passed and about 80 per cent of the regular students. In calculus, no one of the co-operative students failed. The lowest grade received by any co-operative student was 73 (60 being the passing grade and 100 the maximum), and 50 per cent of the class received over 90. In the regular four-year engineering course, on the contrary, about 20 per cent of the students failed in calculus, and few received a grade above 90.

CURRENT NEWS AND NOTES.

ELECTRICAL LABORATORY FOR OXFORD UNIVERSITY.—The London City Company of Drapers has given $110,000 to found an electrical laboratory at Oxford University.

DISMISSES FRANCHISE PETITION.—Justice Erlanger, of the Supreme Court of New York City, has dismissed the petition of Attorney General Jackson to annul the charter of the Consolidated Gas Company.

NEW WIRELESS STATION ON PACIFIC COAST.—The United Wireless Telegraph Company has opened a commercial station at Friday Harbor, Wash., working with Seattle and other Pacific Coast points.

PASSED ON 1050 QUESTIONS.—The Public Service Commission of the Second District of New York passed upon 1050 questions affecting corporations during the first year of its existence. The expenses for the year were $270,000.

GREAT WESTERN POWER COMPANY EXTENDING.—The Great Western Power Company has just let a contract to the Globe Construction Company for the erection of a transformation substation in East Oakland, Cal. The company intends to build a $500,000 power house in Oakland, where 25,000 horse-power will be developed.

FENDERS AND WHEEL GUARDS.—The New York Public Service Commission will hold two public tests of fenders and wheel guards for Greater New York this fall. One will be held at the General Electric Works, Schenectady, about September, and the other at the Westinghouse works, East Pittsburg, probably one month later, so as to accommodate makers and inventors East and West. The tests will occupy several weeks.

CHEAPER CABLE MESSAGES.—A special cable dispatch from London of July 4 says that at the Independence Day banquet at the Hotel Cecil under the auspices of the American Society in London most of the speakers referred to the 2-cent postage between Great Britain and the United States, coupling the name of John Henniker Heaton, who was present. The latter in his reply expressed the firm conviction that there would shortly be penny-a-word cablegrams between England and America. He said: "God has given electricity that now is only at the disposal of millionaires, but soon it will be within the reach of the millions." Mr. Heaton, while disclaiming any official authority for his statements, maintained that the prediction would come to pass.

WORRIED OVER WIRELESS.—According to a special cable dispatch of July 4 to the New York *Times,* Herr Reinhold Sydow, the new German Imperial Secretary of the Treasury, has expressed his regret that the American government has not yet seen fit to ratify the international wireless telegraph convention adopted at the conference of the great powers held in Berlin three years ago. England, which proved rather recalcitrant at the conference, has since adopted the convention without reserve, and Germany fails to understand why the United States, which so actively supported the project during the conference, has withheld its formal sanction. It is supposed in Berlin that rival private wireless interests in America are responsible for the Washington government's delay in affixing its signature to the international agreement. The German Post Offices began last Wednesday accepting wireless telegrams for transmission from the coast to ships anywhere in the world. The postal authorities hope that the public will promptly accustom itself to the new facilities and begin using them on a generous scale.

ELECTRIC RAPID FIRE GUN.—According to a cable dispatch from Dijon, France, an engineer named Ponteaux has invented an electric gun which, without powder or other explosives, is said to be capable of firing 1200 shots a minute.

NEW BRITISH PATENTS ACT.—Owing to a provision in the new British Patents Act, which went into effect Jan. 1 of this year, British manufacturing firms are active in securing rights to manufacture under patents secured in Great Britain by non-British inventors. According to the provision referred to, articles covered by such patents are required to be manufactured in Great Britain to an adequate extent.

SALVAGE FOR CABLE STEAMER.—Judge Sanford B. Dole, of the United States District Court, has decided the salvage suit brought against the owners of the Pacific Mail Line steamship *Manchuria* by the Commercial Cable Company, whose cable repair ship *Restorer* salvaged the liner, by awarding $61,000 to the *Restorer*. The *Manchuria* ran on a reef off Rabbit Island, near Honolulu, during a storm in August of 1906.

PROTECTING ATLANTIC CABLES.—It is announced from London that a committee composed of officials of the Board of Trade and the Foreign Office has been appointed to consider complaints made by the cable companies with reference to the damage done to transatlantic cables by trawlers on the Irish coast, and to devise means whereby this may be prevented in the future. Most of the fishermen are willing to stop fishing at the place on the Irish coast where the damage was done, but a small minority say that the best fishing is obtainable there.

WIRELESS ON THE PACIFIC.—Word arrived from Honolulu, Sandwich Islands, on July 4 that a wireless message was received there from the signal officer of Rear Admiral Sperry's flagship, the *Connecticut,* at San Francisco. This, the first wireless message sent across the Pacific, was relayed by the *Yankton,* which is on her way to Honolulu, and which is arranging daily calls for the voyage of the fleet. Already the local station is in touch with the *Culgoa,* the *St. Louis* and the *Glacier,* and hopes to get into direct communication with the flagship. It is now able to catch faint signals from the California station.

THE EDISON CONVENTION.—President Alex. Dow has issued a notice to the effect that the annual meeting of the Association of Edison Illuminating Companies will be held at the Hotel Aspinwall, Lenox, Mass., on Sept. 15, 16 and 17, with committee meetings on the 14th. The date has been fixed a week later than usual to avoid the summer-end rush. On sending advice in advance, the hotel management will meet any attendants at the convention on the arrival of their train at Pittsfield. As everyone knows, Lenox is a delightful spot, situated in one of the most beautiful regions of the famous Berkshire Hills, and Pittsfield has long been a notable electrical manufacturing center.

THE BEST INVENTION.—It is stated from Paris that over 200,000 readers of the *Petit Journal,* one of the most widely circulated newspapers in France, have just declared it their opinion that the locomotive is the most useful invention of modern times. The newspaper in question recently started a ballot to decide upon the 12 modern discoveries or inventions which had rendered the greatest service to humanity. The list comes in the following order: The locomotive, potatoes, vaccine, the cure of hydrophobia, sugar, the telegraph, matches, the steam boiler, the telephone, petroleum, the sewing machine and soap. While the locomotive received 275,197 votes, soap at the other end of the list received only 117,817. The bicycle received 80,000 votes and the automobile 60,000. As for the trolley car it received the humiliating minority of 22,000 votes. This shows that all phases of locomotion are not equally popular, but then the real trolley car is barely known in France. Thousands of readers of the *Petit Journal* are evidently still confident in the scientific prowess of Lemoine, for they cast their votes in favor of that modern discovery, the artificial electrical diamond.

MEETING OF LAMP TESTERS.—A meeting of all the lamp inspectors in the employ of the Electrical Testing Laboratories was held in New York on July 6, 7 and 8 inclusive. The following papers were presented and discussed: Visual Inspections of Electric Lamps, by C. E. Currier; The Best Procedure in Lamp Inspection, by C. H. Stephens; The Selection of Life Test Samples, by H. E. Allen; The Effect of Varying Test Quantity upon Rejections, by W. F. Ten Eyck; "Bugs" in Photometry, by E. L. Peck; Lamp Inspections at Purchasing Companies' Storehouses, by W. J. Bray; The Criterion of Lamp Value, by A. W. Minty; The value of Laboratory Tests, by W. H. Rolinson; The Functions of a Lamp Inspector, by Geo. H. St. John; The Responsibilities of a Lamp Inspector, by L. J. Lewinson.

SPECIFICATIONS FOR HARD-DRAWN COPPER WIRE.—At the Atlantic City meeting of the American Society for Testing Materials, Messrs. W. H. Bassett and J. H. Clapp presented a paper calling attention to the desirability of introducing standard specifications for hard-drawn copper wire. The authors stated that no two of the specifications already in existence agree as to what should be the minimum permissible tensile strength or variation in diameter, while many of them include other requirements, such as a minimum elastic limit, a minimum number of twists made in different ways and on different lengths of wire and at different rates of rotation. The authors said that the specifications for hard-drawn copper should be standardized as have those for other more common engineering materials.

ADDRESS ON FRANCHISES.—Glenn Marston, of New York, spoke before the Commercial Club of Galesburg, Ill., on June 22 on the subject of franchises. All of the leading men of the city were present, including a number of city officials, and a very interesting discussion followed the address. The general opinion seemed to be that a company should not be handicapped by any restrictions that would hinder its legitimate growth. It was also brought out that the duty of a city in granting franchises was to look out for the patrons of the company in preference to the general taxpayer. Mr. Marston said that the development of any city was dependent on the development of its public utilities, and that any conditions in a franchise which prevented the legitimate growth of a company would react to the detriment of the city. He also claimed that unlimited franchises permitted a rate from 2 to 5 per cent lower than a 50- or 20-year franchise, because under an unlimited franchise the earnings did not have to cover an amount sufficient to repay the investors at the expiration of the franchise.

PROF. GIUSEPPE PONZIO.—A cablegram has been received from Milan announcing the premature death of Prof. Giuseppe Ponzio of the Royal Polytechnic Institute of Milan and one of the most prominent engineers in Italy. In his work he was identified with the wonderful development of industries which grew up in the northern part of Italy during the past 25 years. As a public man, he held for several terms the position of Commissioner of Public Works for the City of Milan, and under his administration took place the major part of the building of the modern quarters of the city. Prof. Ponzio visited America in 1893 and again in 1904 as one of the guests of the American Institute of Electrical Engineers. He was an admirer of American activity, ways and methods, in which he found the expression of his own personality; a quick thinker, a keen observer, a sturdy and manly character, with few personal wants, and most agreeable to others and devoted to his family. One of his students now well known in America is Mr. Philip Torchio, a prominent member of the enginering staff of the New York Edison Company.

Light and Power in a Model Office Building.

By H. THURSTON OWENS.

AN office building, which for completeness of equipment is rarely excelled, has recently been erected in the heart of the insurance district of New York City. This structure, known as the German-American Insurance Building, occupies a triangular-shaped site, having an area of 5184 sq. ft., at the junction formed by Maiden Lane and Liberty Street. Owing to peculiar underground conditions, being in a direct line with old Maiden Lane Creek, it was necessary to excavate to a depth of nearly 50 ft. below the street level. The building is 21 stories and its total cost over $1,000,000.

Electrical energy for lamps and motors is obtained from the mains of the New York Edison Company. The main supply lines for lamps, motors, telephone, fire alarm, ticker and messenger services are placed in a fireproof shaft. The lighting outlets number 1900 and 775 of these are base receptacles.

The insurance company has reserved for its own use the first, fourth, fifth and sixth floors and provisions for adequate lighting have been carried out in great detail, there being nine designs of ornamental fixtures for general illumination and some 15 types of desk fixtures. There is an entrance on Maiden Lane and one on Liberty Street, the elevator concourse between these entrances forming a vestibule for the company's general office, which occupies this floor. This room is finished in Sienna marble and gold, with vaulted ceiling, the illumination being obtained from ceiling lamps placed in rosettes forming part of the design. There are 40 40-watt tantalum lamps installed here, the wiring being so arranged that either half or all can be used. These are the only lamps of this type in use, the general equipment consisting of 50-watt Gem lamps. In addition to the ceiling lamps there are two magnificent bronze standards at the entrance to the company's office, which room, shown in Fig. 1, is finished in a style similar to the lobby, an additional feature of merit being the unusually large windows with casings of bronze.

The lighting fixtures are of three types: chandeliers, brackets and desk lamps, the first two being for general illumination, as each desk is equipped with an individual fixture. The chandeliers are of Renaissance design, made of heavy brass, the finish being Flemish, and are unusually handsome by comparison with other fixtures usually installed in office buildings. There are two fixtures similar in design to the one shown in Fig. 5. These measure 60 in. in length and have a spread of 30½ in.; each of the smaller balls measures 6 in. in diameter and the large one 12 in. There is one 50-watt Gem lamp in each of the smaller balls and five in the large one, the lamps being wired on two circuits so that three lamps in the large ball and alternate lamps on the ring may be used, or the whole installation at one time. Switches for all chandeliers are placed upon the adjacent walls or columns.

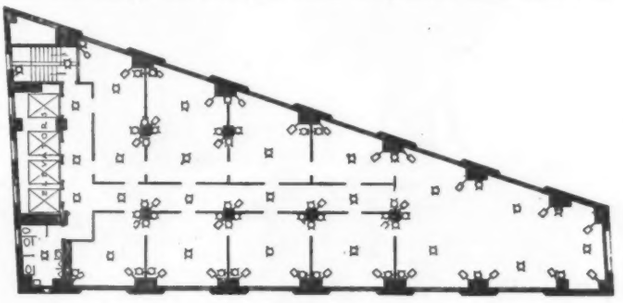


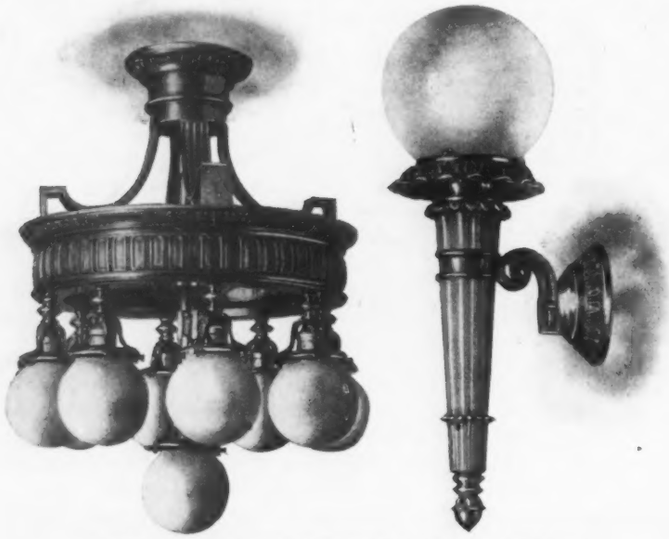
FIG. 2.—TYPICAL FLOOR PLAN.

FIG. 1.—GERMAN-AMERICAN INSURANCE COMPANY'S GENERAL OFFICE.

In this room are also seven similar fixtures slightly smaller and in the private office, a fixture similar to that shown in Fig.

6 is installed. The type of bracket used is shown in Fig. 4 and of these there are 12 installed. The fixture glassware is frosted, rough inside and polished outside.

The 15 types of desk fixtures vary with the kind of desk and the work to be performed. They are all supported by means of No. 16-gage brass tubing, with extra heavy turned fittings; those with swings being provided with check pins. The 7-in. shades used are green cone, white lined porcelain. Each shade is supported by heavy prong holders independent of lamp sockets. In the rooms reserved for the use of the president and the directors, on the fourth floor, the fixtures are somewhat similar to those in use on the main floor, but are smaller, owing to the size and height of the rooms. (See Fig. 3.)



FIGS. 3 AND 4.—CEILING FIXTURE AND WALL BRACKET.

That portion of the building which will be used by tenants has been provided with lighting fixtures on the same generous scale as in the portion which the company occupies. General lighting is provided by means of four-lamp clusters with porcelain reflectors placed 9 ft. above the floor, the greatest distance between centers being 18 ft. The switch control for all of these fixtures is on the adjacent columns or walls. Individual desk fixtures may be connected from the numerous base receptacles and outlets for bracket lamps are provided. (See Fig. 2.) In the corridors the lamps are enclosed in 9-in. frosted ball ceiling fixtures.

The company has provided for its telephone service on the same complete scale as the balance of the equipment. There is a room in the cellar used exclusively by the telephone company for its trunk lines, cross connections, etc. The main telephone riser is placed in 3-in. pipe in the main shaft and is connected with a main distributing box on each floor; from each of these boxes ¾-in. pipe carries lines to four sub-panels. These sub-panels are divided into two compartments, one side for public telephone connections and the other side for ticker and messenger service connections, etc.

The picture molding shown in Fig. 7 is designed as a wire run for all low-tension circuits and is carried around all exterior walls and along all partitions at the height of the sub-panels, to which direct openings are left. In order that the molding would be large enough to carry these wires and not be unsightly, it is backed by a wooden strip 1 in. thick and this has been hollowed for a depth of ½ in., as shown in the

FIG. 5.—CEILING FIXTURE.

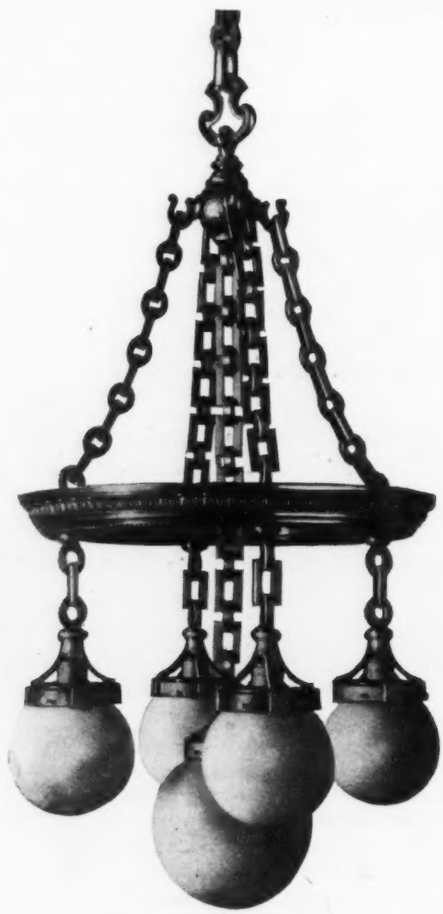


FIG. 6.—CEILING FIXTURE.

diagram. At each column there are telephone outlets with conduit extending to the nearest sub-panel. Risers for telegraph ticker and messenger service are run in pipes at the locations of sub-panels, there being one pipe line for each panel. An interior telephone system has been installed connecting each floor directly with the engine room.

Electricity is also used for driving five ventilating fans, one exhaust and one fresh air supply for the cellar, a similar arrangement for the basement and the first floor, and one exhaust fan in the pent house for removing air from toilet rooms. The centrifugal sump pumps number two, each being driven by a 3-hp motor fitted for automatic control.

A watchman's supervising and fire-alarm system has been installed, there being 24 stations in the building from which hourly notices are sent direct to the main office of the fire alarm company, which makes a daily report to the insurance company as to the regularity of these notices.

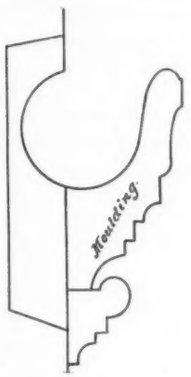


FIG. 7.—PICTURE MOLDING AS WIRE RUN.

The architects of the building were Messrs. Hill and Stout, The Whitney-Steen Company were the general contractors, and the fixtures were manufactured and installed by The Sterling Bronze Company, of New York.

What Is the Ratio of a Transformer?

BY MORTON G. LLOYD.

When the ratio of transformation of a transformer is spoken of in a general way, there is no question as to what is meant by the expression. The same is true also when it is spoken of in a quantitative sense, if only its approximate value is considered. It is simply the ratio of the numbers of turns in the two windings.

When, however, the transformer is to be used in making accurate measurements, as in stepping down from high voltages or currents to the range of ordinary instruments, it is necessary to know the exact ratio of the technical pressure or of the currents. In any case where the regulation is of importance, it is desirable to know the ratio of terminal pressures, or in series transformers of the currents.

Owing to internal resistance and to magnetic leakage, the ratio of terminal voltages in a potential transformer is never quite the same as the ratio of turns. In consequence of this, it is customary for the manufacturers to alter slightly one of the windings from the number necessary to give the nominal ratio of turns. The ratio of turns is not indicated on the name-plate, and is generally unknown to the user. The name-plate should and usually does tell the ratio of terminal voltages, for this is the ratio of interest to the user.

The ratio of terminal voltages varies with the conditions of use, such as load, frequency, etc. The ratio given by the manufacturer upon the name-plate usually refers to a specified frequency and voltage, and is correct for some load intermediate between no load and full load. The greatest discrepancy between this nominal ratio and the actual ratio under various conditions of use will then usually be less than the value of the "regulation."

The "regulation" is defined in the standardization rules of the American Institute of Electrical Engineers (No. 197) to be "the ratio of the rise of secondary terminal voltage from rated non-inductive load to no load (at constant primary impressed terminal voltage) to the secondary terminal voltage at rated load." The rules do not define the ratio of transformation.

What, then, should be understood by the expression "ratio of a transformer"? Should it represent a quantity which is fixed by the number of conductors, or a quantity which varies with the conditions of use? Should it represent a quantity whose value is secreted in the archives of the manufacturer or a quantity whose value can be determined by a simple measurement? Should it represent a quantity whose exact value is of importance to the user, or a quantity which it is never useful to know except approximately?

If we may judge by the published writings upon this subject, there is at present a great lack of uniformity in the meaning of the expression as used by different engineers and writers of text-books. The following definitions represent the different senses in which the expression is used:

(a) The ratio of the number of turns in the primary winding to the number of turns in the secondary winding.

(b) The ratio of the number of secondary to the number of primary turns.

(c) The ratio of the terminal voltages.

(d) The ratio of the induced voltages in the two windings. On account of leakage this is not the same as the ratio of turns.

(e) The ratio of terminal voltages under no load.

Of the American writers, Baum gives definition (a), Steinmetz, Sheldon and Mason give (b), while Jackson gives (c). Bedell gives definition (a), but afterward (p. 238) speaks of change of ratio with capacity load. Raymond does not give a definition of ratio, but speaks of regulation as the difference of ratio between no load and full load. Houston's Electrical Dictionary (fourth edition) gives definition (c). Of the English writers, Adams and Lamb give (c), Thompson and Fleming give (d), Russell gives (e). The expression is not defined by Sloane (Elec. Dict.), Kapp, Houston and Kennelly, Franklin and Williamson, Slingo and Brooker, Oudin or Still.

Definition (a) is in principle the same as (b), but inverted, and better represents ordinary practice in conversation and name-plates.

With regard to series transformers, similar conditions exist. The primary ampere-turns differ from the secondary ampere-turns by the amount of the magnetizing ampere-turns. The ratio of currents is consequently different from the ratio of turns and varies with load, with secondary impedance, etc. The ratio given on the name-plate is not the same as the ratio of turns, for the practice among the manufacturers of omitting several turns in the secondary to compensate for losses is even more universal here than in the case of potential transformers. The ratio of turns is consequently unknown to the user, and it may well remain so, since he is interested primarily in the ratio of the currents.

The definition of ratio in this case admits of the same variety of choice as for the potential transformer. One case has come to my notice where a still different meaning was employed (*Trans. A. I. E. E.*, vol. 25, p. 717, 1906). In using a series transformer with a wattmeter the author of this article makes the term "ratio" involve the phase relations of the two currents, since it is taken as the ratio of the true power to the reading of the wattmeter.

In the case of the constant-current transformer used with primary on a constant-potential circuit, the ratio of potentials and of currents are of little interest and their value need not be known by the user.

No word should be used by technical and scientific men which has not a definite meaning, and in view of the great divergence in usage of the expression "ratio of a transformer" it seems very desirable that a definition should be included in the code of the American Institute of Electrical Engineers.

This definition should be one which will make the expression most useful to the engineer, and to the writer the following appear to have this qualification and are, therefore, submitted for the approval of the electrical fraternity and for adoption in the standardization rules of the institute:

"The ratio of a potential transformer is the ratio of the effective primary terminal voltage to the effective secondary terminal voltage.

"The ratio of a current transformer is the ratio of the effective primary current to the effective secondary current."

These definitions make the ratio a variable quantity depend-

ing upon the conditions in the secondary circuit. The "regulation" of a potential transformer is then the change in ratio between full load and no load expressed as a fraction of the ratio at full load.

If it be desired to define the expression so that the ratio shall have a fixed value for a given transformer, then definition (e) might be adopted for potential transformers, but for current transformers it would be hard to define the expression in a way that would enable the user to determine the ratio.

Whatever may be the consensus of opinion on this subject, the term as defined should be used with a precise meaning and not in the loose and variable way now so prevalent.

The Exact Circular Current-Locus of the Induction Motor.

By K. J. Laurell.

The numerous contributions to the theory of the induction motor that have been suggested from time to time show two general methods for the treatment of the motor and the derivation of the well-known current locus, namely, one based on the interrelations of the different fields in the motor, and the other on the equivalent circuits, the motor in the latter case being considered as a stationary transformer. In the latter method, the most prominent feature of which is simplicity, the characteristics of the motor are determined by definite alternating-current constants.

As is now fully recognized, the equivalent circuits of the induction motor can be represented by the circuits shown in Fig. 1. Thus, the performance of an induction motor is entirely determined by six "constants," as follows:

x_1 = primary reactance; x_2 = secondary reactance;
r_1 = primary resistance; r_2 = secondary resistance;
b = shunted susceptance; g = shunted conductance.

Let z_1 = primary impedance, z_2 = secondary impedance, and y = shunted admittance, then

$$z_1^2 = x_1^2 + r_1^2; \qquad z_2^2 = x_2^2 + r_2^2; \qquad y^2 = b^2 + g^2.$$

Moreover, in Fig. 1, r represents the variable fictitious resistance that consumes power equal to the output of the motor. It is to be recalled that if $R = r + r_2$ the slip of the rotor with synchronism as unity can be expressed as $s = r_2 \div R$.

The problem for which a solution is offered below is to determine the correct locus of the primary current, I_1 as r is changed from zero to infinite value. In the following it will be shown that the correct locus for I_1 is a real circle if the "constants" of the motor can be considered constant—which within the operating range is true. The best practical result is obtained if, when determining these "constants" in the usual way by short-circuit and no-load tests, the values for the reactance and the resistance refer to normal full-load current, and those for the shunted susceptance and conductance refer to normal impressed internal voltage.

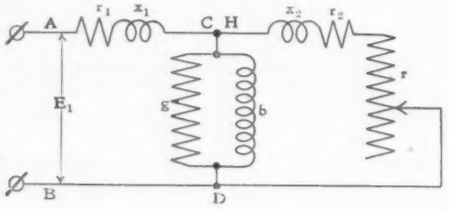


FIG. 1.—EQUIVALENT ELECTRICAL CIRCUITS OF A POLYPHASE INDUCTION MOTOR.

Due to the fact that in most cases the primary impedance has relatively a very small value compared to the equivalent impedance value of the shunted admittance, the circuits in Fig. 1 are often so changed that the shunted-admittance circuit bg is placed between A and B, in order to simplify the treatment. Experience shows that the current locus thus obtained gives good values for most induction motors. However, when dealing with small motors, and especially with single-phase motors, the error obtained by using the approximate method is not negligible. In the following the current locus of the exact equivalent circuits will be determined.

Suppose that, for a certain value of the variable resistance r, the magnitude and time-phase position of the current I_1 are as shown in Fig. 2.

This current can be divided in two components, one in time-phase and the other in time-quadrature, with the impressed e.m.f. E_1. The in-phase or power component is equal to $G \times E_1$, and the quadrature component is equal to $B \times E_1$ where G and B are the total conductance and the total susceptance of the circuits. Obviously, it is sufficient for the present purpose to determine the locus of the total admittance as r is changed; that is, to determine the current locus for unity impressed e.m.f.

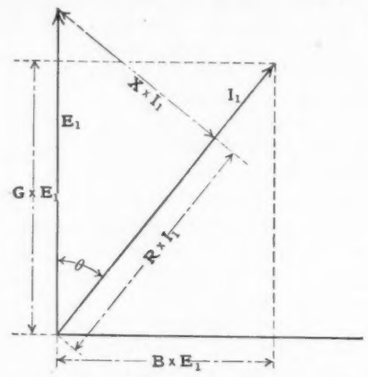


FIG. 2.—COMPONENTS OF CURRENT AND E.M.F.

The relations between the equivalent values of the conductance G, susceptance B, resistance R, and reactance X of any circuit are expressed by the following well-known equations:

$$G = R \div (R^2 + X^2). \tag{1}$$
$$B = X \div (R^2 + X^2). \tag{2}$$
$$R = G \div (G^2 + B^2). \tag{3}$$
$$X = B \div (G^2 + B^2). \tag{4}$$

If, as assumed above, the total conductance and susceptance of the circuits shown in Fig. 1 are G and B mhos, the total resistance and reactance is given in ohms by equations (3) and (4).

Thus, subtracting the values of the primary quantities, the resistance and reactance between the points C and D in Fig. 1 are expressed by equations (5) and (6):

$$\alpha = [G \div (G^2 + B^2)] - r_1. \tag{5}$$
$$\beta = [B \div (G^2 + B^2)] - x_1 \tag{6}$$

Equations (5) and (6) can now be used for determining the equivalent conductance and susceptance between the same two points, C and D (Fig. 1), and so on. In this way the following table has been obtained:

Between Points on Fig. 1	Conductance on Resistance	Susceptance on Reactance	Unit
A, D	G	B	*mho*
C, D	$\frac{G}{G^2 + B^2} - r_1 = \alpha$	$\frac{B}{G^2 + B^2} - x_1 = \beta$	*ohm*
H, D	$\frac{\alpha}{\alpha^2 + \beta^2} - g = \gamma$	$\frac{\beta}{\alpha^2 + \beta^2} - b = \delta$	*mho*
H, D	$\frac{\gamma}{\gamma^2 + \delta^2} = R = r_2 + r$ (7)	$\frac{\delta}{\gamma^2 + \delta^2} = x_2$ (8)	*ohm*

It is evident that from equation (8) the locus for G and B may be obtained.

By transformation of (8) and elimination of γ and δ, there is obtained

$$x_2 = \frac{\beta - b\,(\alpha^2 + \beta^2)}{1 - 2g\alpha - 2b\beta + (b^2 + g^2)\,(\alpha^2 + \beta^2)} \tag{9}$$

$$(\alpha^2 + \beta^2)\,(b + x_2 y^2) - 2g x_2 \alpha - (2b x_2 + 1)\,\beta + x_2 = 0. \tag{10}$$

hence, by eliminating α and β

$$(G^2+B^2)\ (x_0+bz_1^2+x_2y^2z_1^2+2gr_1x_2+2bx_1x_2)-2G\ (br_1+gx_2+r_1x_2y^2)-2B\ (bx_0+\tfrac{1}{2}+x_1x_2y^2)+b+x_2y^2=0 \quad (11)$$

Equation (11) represents a circle, since it can be transformed to $(G-m)^2+(B-l)^2=n^2$, if the constants l, m and n have the following values:

$$l=\frac{bx_0+\frac{1}{2}+x_1x_2y^2}{A}\ ;\ m=\frac{br_1+gx_2+r_1x_2y^2}{A}\ ;\ n=\frac{1}{2A}$$

where $A=x_0+bz_1^2+x_2y^2z_1^2+2bx_1x_2+2gr_1x_2$.

This result is correct for *all* values of the "constants" under all conditions. However, when dealing with an ordinary induction motor it is evident that all terms containing y^2 are negligible in comparison with the other terms. Hence it is permissible to rewrite the values of the constants, A, l, m and n as follows:

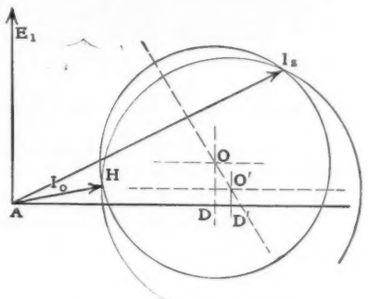


FIG. 3.—CURRENT LOCUS.

$$A=x_0+bz_1^2+2gr_1x_2+2bx_1x_2;\ l=\frac{b\ (x_1+x_2)+\frac{1}{2}}{A}$$

$$m=\frac{br_1+gx_2}{A}\ ;\ n=\frac{1}{2A}$$

In many motors, the circuit "constants" bear approximately the following relations to each other, $x_1=x_2=\frac{x_0}{2}=r_1=r_2$ and $b=4g$. Assuming these relations to be exact, the constant A can be rewritten as $A=x_0+1.13bx_0^2$; x_0 being (x_1+x_2).

The second value of A will give a satisfactory accuracy in the case of all motors except those of extremely small and very large ratings.

From the admittance-locus the current diagram can be determined by multiplying the admittance values with the value for the voltage. Fig. 3 shows how the true current locus is drawn, compared with the approximate circle.

Instructions for the construction of the correct current locus are as follows:

Make $OD=mE_1$, and $OH=nE_1$.

The other circle is obtained by making $O'D'=gE_1$ and $O'H=E_1\div 2\ (x_1+x_2)$.

The approximation made to obtain the second diagram will be appreciated if the correct values of m and n are compared with g and $1\div(x_1+x_2)$. The value of m for the motor chosen is $2g$ instead of g. From Fig. 3 it is now clear why the approximate circle will give good values; it depends upon the fact that the errors introduced eliminate each other within the operating range of the motor, as illustrated by the performance of the 2-hp motor discussed below.

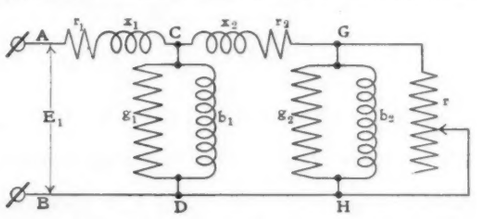


FIG. 4.—EQUIVALENT ELECTRIC CIRCUITS OF A SINGLE-PHASE INDUCTION MOTOR.

SINGLE-PHASE MOTORS.

The method above obtained will now be used for determining the correct current locus of the single-phase induction motor.

The equivalent electrical circuits of this motor are shown in Fig. 4.

The only difference between the circuits of Fig. 1 and those of Fig. 4 is the addition of the shunted circuit, b_2g_2, which depends upon the so-called "speed field." Using the above method, the following table can be derived:

Between Points in Fig. 4	Conductance on Resistance	Susceptance on Reactance	Unit
A, B	G	B	*mho*
C, D	$\frac{G}{G^2+B^2}-r_1=\alpha$ (12)	$\frac{B}{G^2+B^2}-x_1=\beta$ (13)	*ohm*
C, H	$\frac{\alpha}{\alpha^2+\beta^2}-g_1=\gamma$ (14)	$\frac{\beta}{\alpha^2+\beta^2}-b_1=\delta$ (15)	*mho*
G, H	$\frac{\gamma}{\gamma^2+\delta^2}-r_2=\varepsilon$ (16)	$\frac{\delta}{\gamma^2+\delta^2}-x_2=\zeta$ (17)	*ohm*
G, H	$\frac{\varepsilon}{\varepsilon^2+\zeta^2}=g_2+\frac{1}{r}$ (18)	$\frac{\zeta}{\varepsilon^2+\zeta^2}=b_2$ (19)	*mho*

From equation (19) the correct current locus can be determined. Combining (16) and (17) with (19)

$$(\gamma^2+\delta^2)\ (x_2+b_2x_2^2)-2b_2r_2\gamma-(2b_2x_2+1)\ \delta+b_2=0$$

Eliminating γ and δ with (14) and (15).

$$(\alpha^2+\beta^2)\ (b_0+2b_2r_2g_1+2b_1b_2x_2+y_1^2x_2+y_1^2b_2z_2^2)-2\alpha\ (g_1x_2+b_2r_2+b_2g_1z_2^2)-2\beta\ (b_0x_2+\tfrac{1}{2}+b_1b_2^2z_2^2)+x_2+b_2z_2^2=0$$

Where $b_0=b_1+b_2$; $g_0=g_1+g_2$ and $x_0=x_1+x_2$

In dealing with a commercial motor all terms containing b^2 and g^2 can be neglected without involving any measureable error. The equation above can thus be simplified to

$$(\alpha^2+\beta^2)\ b_0-2\alpha\ (g_1x_2+b_2r_2)-2\beta\ (b_0x_2+\tfrac{1}{2})+x_2+b_2z_2^2=0$$

Combining this equation with (12) and (13),

$$(G^2+B^2)\ (x_0+b_0z_1^2+b_2z_2^2+2g_1r_1x_2+2b_2r_1r_2+2b_0x_1x_2)-2G\ (b_0r_1+g_1x_2+b_2r_2)-2B\ (b_0x_0+\tfrac{1}{2})+b_0=0$$

This equation, which shows that the locus is a true circle, can be written: $(G-m)^2+(B-l)^2=n^2$, if the constants l, m and n have the following values:

$$l=\frac{b_0(x_1+x_2)+\frac{1}{2}}{A}\ ;\ m=\frac{b_0r_1+g_1x_2+b_2r_2}{A}\ ;\ n=\frac{1}{2A}$$

where $A=x_1+x_2+b_0z_1^2+b_2z_2^2+2g_1r_1x_2+2b_2r_1r_2+2b_0x_1x_2$.

Assuming that $b_1=b_2$; $x_1=x_2=r_1=r_2$, $b=4g$, and letting $b_0=b_1+b_2$ and $x_0=x_1+x_2$, the constant A may be expressed as $A=x_0+1.56\ b_0x_0^2$.

The values of m and n can now be used for determining the current locus, as was done above.

It is instructive to compare the calculated circular current locus of a motor with the locus actually obtained by loading the machine. A 2-hp, 4-pole, 60-cycle, 110-volt, three-phase motor has the following "constants" per phase-winding, obtained from short-circuit and no-load tests.

$x_1=0.32$ ohm, $x_2=0.32$ ohm, $b=0.081$ mho

$r_1=0.22$ ohm, $r_2=0.28$ ohm, $g=0.018$ mho.

Hence $A=x_0+1.13\ b_0x_0^2=0.68$

$$m=\frac{br_1+gx_2}{A}=0.035\text{ mho},\ n=\frac{1}{2A}=0.73\text{ mho}.$$

The equivalent single-phase current locus is shown in Fig. (5) by the circle having its center at O', the points on which are determined by $O'D'=0.035\times 110=3.85$ amp, the radius $=0.73\times 110=80$ amp, and a no-load current I_0, the components of which are $0.081\times 110=8.9$ amp, and $0.018\times 110=2$ amp. It is to be observed that the measurable current per lead is $(1\div\sqrt{3})$ times the value obtained from this diagram.

The circle with center at B' shows the current locus which would have been obtained if the usual method had been employed.

The "constants" for this motor used as a single-phase machine are

$x_1=0.64$ ohm; $x_2=0.64$ ohm;

$r_1=0.44$ ohm; $r_2=0.56$ ohm;

$b_0=b_1+b_2=0.081$; $g_0=g_1+g_2=0.018$ mho.

Hence $m=0.044$ mho, $n=0.338$ mho.

Thus the current locus is obtained by making $OD = 0.044 \times 110 = 4.85$ amp, and the radius equal to $0.338 \times 110 = 37.2$ amp.

A closer study of Fig. 5 will show that for this motor used as a single-phase machine the difference between the two diagrams obtained is not negligible. As a three-phase machine the difference is very slight within the operating range, due to the fact that the errors neutralize each other. In both cases the "correct" diagram will give the higher power factor. The actual current locus of this machine as found under load test differs inappreciably from the "true" current locus as found above.

In order to show the influence of the primary resistance on the diagram, the circle having its center at C is added for the case where the primary resistance $r_1 = 1$ ohm.

As mentioned above, the slip of the polyphase induction motor can easily be obtained.

Combining equations (7) and (8)

$$\frac{x_2}{R} = \frac{\delta}{\gamma} \text{ and } s = \frac{r_2}{x_2}\frac{\delta}{\gamma}$$

moreover the input is $W = E_1^2 G$, in watts; the torque is $D =$

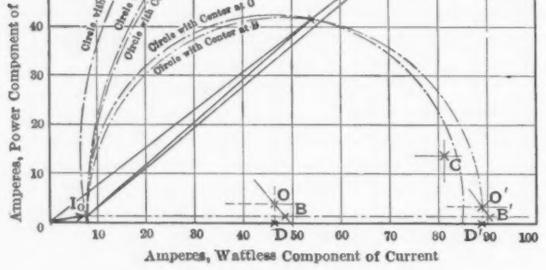


FIG. 5.—COMPARISON OF CURRENT LOCI.

$E_1^2 G - I_1^2 r_1 = aI_1^2$, in synchronous watts; and the output is $P = (1 - s)\, D$, in watts.

The relation between I_1 and I_2 is given by the equation

$$aI_1^2 = R\, I_2^2, \text{ or } I_2^2 = s\,\frac{a}{r_2} - I_1^2$$

Each of these quantities can be treated at length, and the expression can be simplified according to the method outlined above. The result will show that the usual method of determining the output, torque, slip, etc., employing straight lines in the diagram will give satisfactory values for most commercial motors.

Relation Between Number of Turns and Resistance of Magnet Spool Windings.

By Paul M. Rainey.

THERE is given below a description of a simple method for treating that division of electromagnet design which has to deal with the relation between the number of turns of a conductor making up a magnet coil and the electrical resistance of the coil. The principles underlying these relations are familiar, although the methods usually employed are more or less tedious. The method herein described treats only of magnets having circular cores and conductors of circular cross-section. It may be observed, however, that the method yields itself readily to other cases. The method of calculation described, which no doubt is familiar, is given here only as an explanation of the curves explained later.

Before entering into a discussion of the question proper, it may be well to point out that accurate calculation of the number of turns of a certain commercial size of wire to give a required resistance, when wound under factory conditions on a magnet spool of given length and size of core, is made impossible by the various conditions which are imposed. This is particularly true in the case of the smaller sizes of wire, say, from No. 30 to No. 40 B. & S. gage. The principal variations which occur to make accurate calculations impossible and which are beyond the control of the individual who is called upon to design a winding, may be briefly classified as follows: (*a*) Variation in the diameter and cross-section of the conductor; (*b*) variation in the conductivity of the conducting material; (*c*) variation in the thickness of the insulating material on the

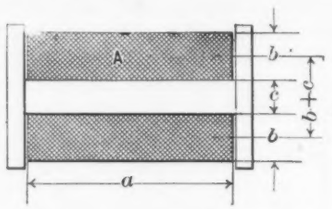


FIG. 1.—DIMENSIONS OF WINDINGS AND SPOOL.

conductor and between layers, etc.; (*d*) variations due to the personal factors of winding operations, etc.

An analysis of the problem initially disregarding all of the variations mentioned would justify the following conclusions:

The number of turns N in a coil, using a certain size of wire, is directly proportional to the area A of the cross-section of the winding.

That is, referring to Fig. 1, N varies as A where $A = ab$.

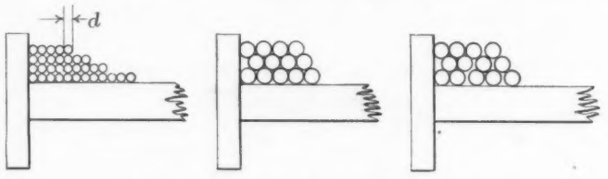
The resistance of R of a coil using a certain size of wire, is directly proportional to the volume V of the space occupied by the winding. Referring again to Fig. 1, R varies as V, where $V = fA$, and $f =$ the length of a mean turn $= 3.1416\ (b + c)$ or $V = 3.1416\ ab\ (b + c)$.

If it were possible to wind coils and maintain the position of the conductors relative to each other, as shown in Fig. 2, the relation between the number of turns N and the area of cross-section A would be represented by the equation

$$N = \frac{A}{d^2}$$

where d is the outside diameter of the insulated wire.

Since, however, the real conditions which exist are more nearly illustrated by Fig. 3 in the case of good winding and Fig. 4 in the case of poor winding, the impracticability of the above equation is at once recognized. It is possible, however, to make the equation practicable by replacing d^2 by a constant "K." It will be noted that since "K" is equal to $\frac{A}{N}$ it can be readily determined for any size and kind of wire by simple experiment. When once determined it is available for all problems



FIGS. 2, 3 AND 4.—WIRES IN PLACE ON SPOOLS.

using the same size of wire. It is interesting to note that the constant K is also equal to $\frac{V}{L}$, where L is equal to the total length of the wire. This is easily derived from the equation

$$K = \frac{A}{N},$$

by multiplying both the numerator and the denominator of the expression $\frac{A}{N}$ by f, the length of a mean turn, since $Af = V$ and $Nf = L$.

In determining the value of K for a given size and kind of wire, care should be taken to insure that the coils from which the constant is determined are representative of average conditions. The constant K for a given size and kind of wire may be different in two factories or for two different winders in one

factory owing to various causes, such as difference in the inspection limits for the diameter of the wire and in the thickness of insulation on the wire, variation in the amount of insulation between layers, variation in the skill of winders, management, etc.

In general, winding problems present themselves in one of the following three forms, or in some form that can readily be reduced to one of these forms: (1) Required the size of wire to wind a given spool to a given resistance; (2) required the size of wire to wind a spool to a given number of turns; (3) required the size of wire to wind a spool to a given resistance and a given number of turns. It will be noted that (3) is in reality a combination of (1) and (2).

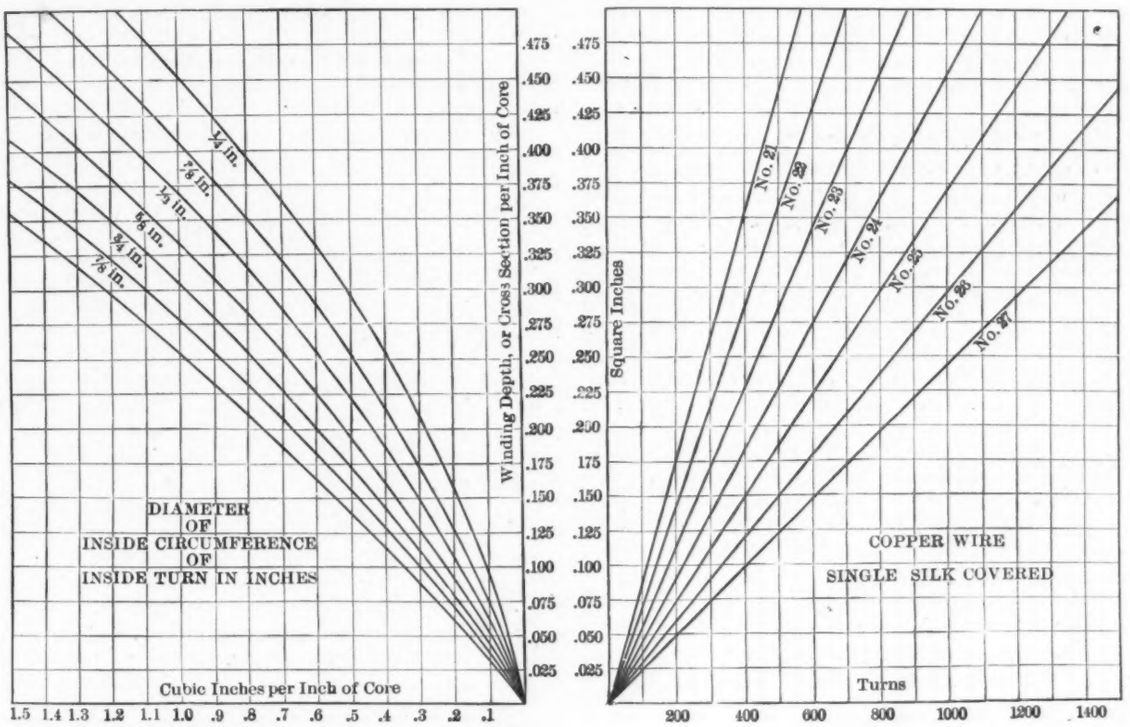
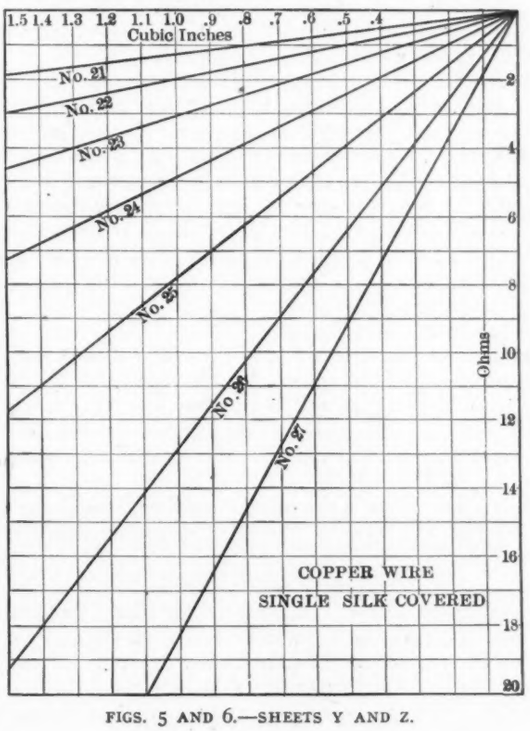

Winding Depth, or Cross Section per Inch of Core
Square Inches
.475 .450 .425 .400 .375 .350 .325 .300 .275 .250 .225 .200 .175 .150 .125 .100 .075 .050 .025
3/4 in.
7/8 in.
1 in.
1 1/8 in.
1 1/4 in.
1 3/8 in.
DIAMETER OF INSIDE CIRCUMFERENCE OF INSIDE TURN IN INCHES
Cubic Inches per Inch of Core
1.5 1.4 1.3 1.2 1.1 1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1
No. 21
No. 22
No. 23
No. 24
No. 25
No. 26
No. 27
COPPER WIRE
SINGLE SILK COVERED
Turns
200 400 600 800 1000 1200 1400

FIG. 7.—SHEET X.



FIGS. 5 AND 6.—SHEETS Y AND Z.

The usual steps in the calculation of all of these winding problems are represented by the following equations:

$$N = \frac{A}{K} = \frac{ab}{K}$$

$$V = Af = 3.1416\, ab\, (b + c)$$

$$L = \frac{V}{K} = Nf = 3.1416\, \frac{ab\, (b + c)}{K}$$

$$R = \frac{Lr}{12} = 3.1416\, \frac{abr\, (b + c)}{12K} = \frac{.2618\, abr\, (b + c)}{K}$$

where r is equal to the resistance per foot of the given wire, and all dimensions are expressed in inches. Allowance must be made for insulating washers and for the insulation on the core.

As a precaution against trouble in winding, by securing the required electrical resistance before the desired number of turns have been wound on, it is well to base the calculations on the minimum number of turns and on wire of maximum resistance. This means that the actual average winding will require more turns than specified to give the required resistance; but since this is generally to be preferred rather than too few turns and the specified resistance, the data for the accompanying curves have been calculated on this basis.

An examination of these curves will show that they are, in fact, a graphical representation of the general method described above. The principal modification being that the length of spool a has been limited to unity (1 in.), thus making the winding depth in inches numerically equal to the cross-section in square inches. Bearing this in mind, an explanation of the curves on sheets marked "X," "Y" and "Z" is hardly necessary. These curves apply only to the use of copper wire having single silk insulation.

Referring to the sheet marked "X" it will be noted that the relation between the number of turns N and the cross-section of winding space A for each size and kind of wire is represented by a straight line. This is as would be expected, since the number of turns is directly proportional to the area of the cross-section of the winding space.

Curve sheet "Y" shows the relation between the winding depth b or cross-section A per inch of length of core and the

volume V per inch length of core for the various sizes of cores ⅛ in., ¼ in., ⅜ in., etc., to 1 in. For sizes of cores or for outside diameters of inner windings between the specified values it is necessary to interpolate.

On sheet marked "Z" each size of wire is represented by a straight line, which shows the relation between volume in cubic inches and electrical resistance in ohms. This is also in accordance with the former assumption that the electrical resistance R of a coil of a given size of wire is directly proportional to the volume of the space occupied by the winding.

By way of illustration, suppose that it is desired to find the size of wire to use for a spool having the following dimensions in order that the resistance may be 10 ohms:

Length of winding space $a = 2$ in.
Allowable winding depth, $b = ¼$ in.
Diameter of core and insulation, $c = ½$ in.

Since the spool is 2 in. long the resistance per inch of core will be 5 ohms. On sheet "Y" the volume of winding space per inch of core occupied by a winding ¼ in. deep on a ½-in. core is found to be about 0.39 cu. in. Sheet "Z" shows that this spool wound with No. 25 single-silk-covered copper wire will have a resistance of about 4.6 ohms per inch, or a total resistance of 9.2 ohms, which is too low. A second trial shows that with No. 26 wire a resistance of 5 ohms will require a winding volume of only 0.39 cu. in. instead of 0.59. Referring again to sheet "Y" it will be noted that the winding depth which will give this volume is about 0.18 in. instead of 0.25 in. Following the line across sheet "X" to its intersection with the line for No. 26 wire shows that 620 turns will be required per inch of core. The solution of the problem is, therefore, 1240 turns of No. 26 single-silk-covered copper wire, the resistance being 10 ohms.

Suppose that it is desired to find the size of single-silk-covered copper wire to wind approximately 2850 turns upon a spool having the following dimensions so as to give a resistance of 25 ohms:

Length of winding space, $a = 2½$ in.
Allowable winding depth, $b = ⅜$ in.
Diameter of core and insulation, $c = ⅜$ in.

A total of 2850 turns and a resistance of 25 ohms distributed over 2½ in. is equivalent to 1140 turns and 10 ohms per inch of core. Examining the sheet marked "X" it is found that 1015 turns of No. 25 wire per inch will give a depth of ⅜ in. and that 1260 turns of No. 26 wire may be placed per inch for the same depth. This shows that the wire must be smaller than No. 25 since it is impossible to secure the desired number of turns with this particular size.

Following the 0.375-in. winding-depth line across the curve sheet "Y" to its intersection with the curve for ⅜ in. inside diameter of the inside turn and then downward, it is found that 1263 turns per inch of No. 26 wire on a ⅜-in. core will occupy a volume of about 0.88 cu. in.

From sheet marked "Z" it is found that 0.88 cu. in. of No. 26 wire has a resistance of about 11.4 ohms. Since both the turns and the resistance are slightly higher than desired, it would appear that No. 26 is the proper size to use. It is well always to check the results by reverse process. Sheet "Z" shows that 10 ohms of No. 26 wire will occupy about 0.785 cu. in. Sheet "Y" shows that 0.785 cu. in. of winding space per inch with a ⅜-in. core is equivalent to a winding depth of 0.345 in., or cross-section of 0.345 sq. in. Sheet "Y" shows that 0.345 sq. in. of winding cross-section is sufficient for 1160 turns of No. 26 wire. Since this value is only 20 turns per inch in excess of that specified, the problem may be considered solved.

The above examples serve to show the varied uses to which these curves can be put as well as their practicability, since for 1-in. length of winding area the resistance corresponding to any number of turns of any size of wire on any size of core and the depth the winding will occupy may be read at a glance. By adding to sheets marked "X" and "Z" similar sheets for other kinds and sizes of wire, all problems of the above-described nature for a given range in size of spools can be handled in the same manner.

Single-Phase Railway in England.

THE single-phase railway recently placed in operation between Heysham, Morecambe and Lancaster, in England, possesses many features of interest to electrical engineers. Although the total route length is only 21 miles, an e.m.f. of 6600 volts has been selected for the trolley, which is of the reinforced-catenary type, receiving energy at a frequency of 25 cycles.

REINFORCED-CATENARY LINE CONSTRUCTION.

In the design of the overhead contact wire and its supports effort has been made to obtain the maximum of flexibility without weakening the structure. The catenary wire is in reality two cables, which are clipped together throughout their length, except for about 3 ft. on either side of the insulator, where they divide to pass through the grooves of a ring, the grooves being on opposite sides of the insulators. The catenary is, therefore, free to move for this distance and thus the strains in spans due to unequal loading are equalized; at the same time, the catenary is secure in the case of the breaking of the contact-wire, as has actually been proved by experience.

The contact-wire is suspended by loops about 4 in. long from a steel cable, called the auxiliary wire, which in turn is suspended from the catenary cables, the main catenary span being broken up into six short spans on the auxiliary. The 4-in. loops are fixed to the contact-wire, but are movable on the auxiliary wire.

The contact-wire, which is of the figure 8 section having an area of 70 sq. mm, is run in lengths of from 2400 ft. to 3000 ft. One end of each length is fixed through insulators to a terminal gantry and the other end is attached through suitable pulleys, etc., to a suspended mass weighing about 1200 lb. As the fixed end is always that at which the train enters, and the weighted end that at which the train leaves, the tendency of the pantograph bow is, therefore, always to straighten the contact-wire. The wire is given a horizontal stagger of from 1 ft. to 1½ ft. on each side of the center of the track. The values for the tension in the wire and the stagger were selected after experimental operation covering several months.

The gantries are connected together by a separate overhead steel cable, which is connected to ground at half-mile intervals, the same grounding plates being used for lightning arresters of the horn type, the object being to diminish the number of plates requiring attention and thus to give better security from danger due to the poles being charged through by leaky insulators. In each case the grounded steel cable has been erected between the contact-wire and the overhead telegraph wires on one side of the line, and it is believed that its presence has had a great effect in reducing the electrostatic induction from the contact-wire to the telegraph wires.

As will be noted from Fig. 3, the steel bolt which supports an insulator is encased in ebonite. Moreover, the insulator itself is in two portions and is very massive. The insulator is so shaped that when used in combination with the twin catenary cable the side strain of the overhead wiring falls below the level of the inside bolt, and there is no point at which the catenary cable itself is deformed by the pressure of any clamp of any sort, and no point at which the mechanical waves tend to break the wire by reflection.

MOTOR-GENERATORS.

The overhead system is fed with electrical energy directly at 6600 volts from two Electric Construction Company motor-generators, each of which consists of a 460-volt direct-current commutating-pole motor mounted on the same shaft with a 25-cycle alternator. The shaft is carried on ball bearings, which have proved very satisfactory in minimizing the starting current and the no-load loss.

The alternator has a three-phase, star-connected winding, so that if one winding breaks down the other two may be used for the single-phase supply; no other use is made of the three-phase connections. The machine is of the standard internal revolving-field type. Exciting current is obtained from an exciter which is mounted on the end of the bedplate and driven by

spur-gears at about 1100 r.p.m. This exciter has laminated field cores and is compound wound, its series winding carrying a portion of the main motor current, so that (so far at least as varying loads of equal power factor are concerned) the tendency of the e.m.f. of the alternator to decrease is thus compensated for. Compensation for varying power factors is obtained by means of a regulator which decreases or increases the resistance in the shunt-field circuit of the exciter by the action of solenoids according to whether the voltage of the alternator is above or below the desired value.

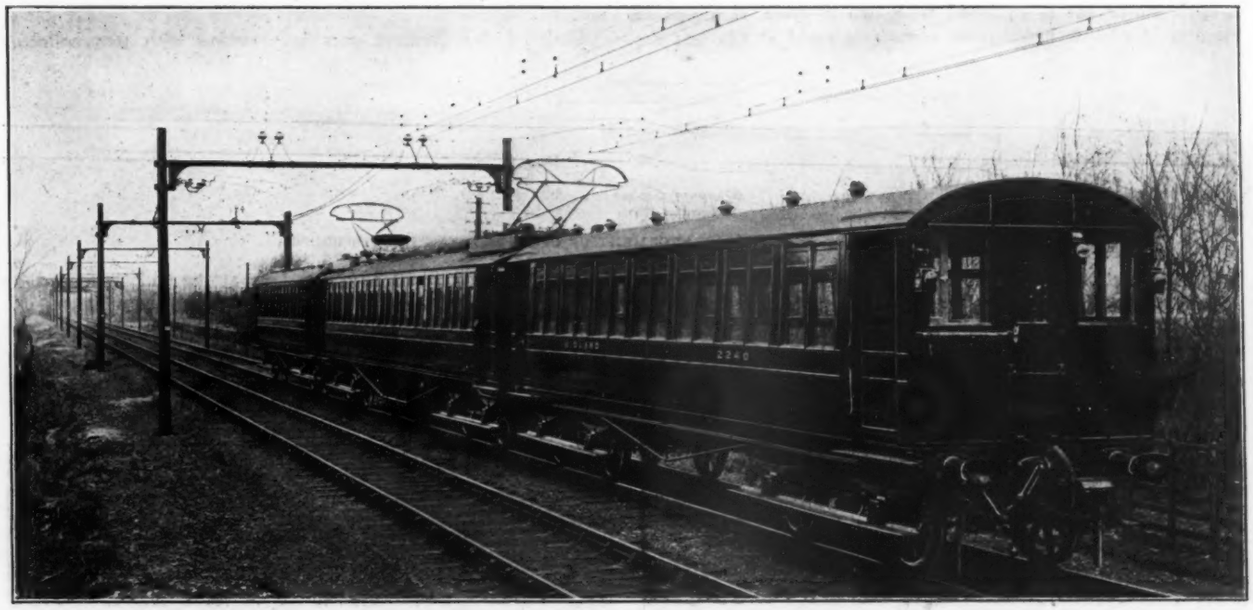


FIG. 1.—GENERAL VIEW OF SINGLE-PHASE RAILWAY.

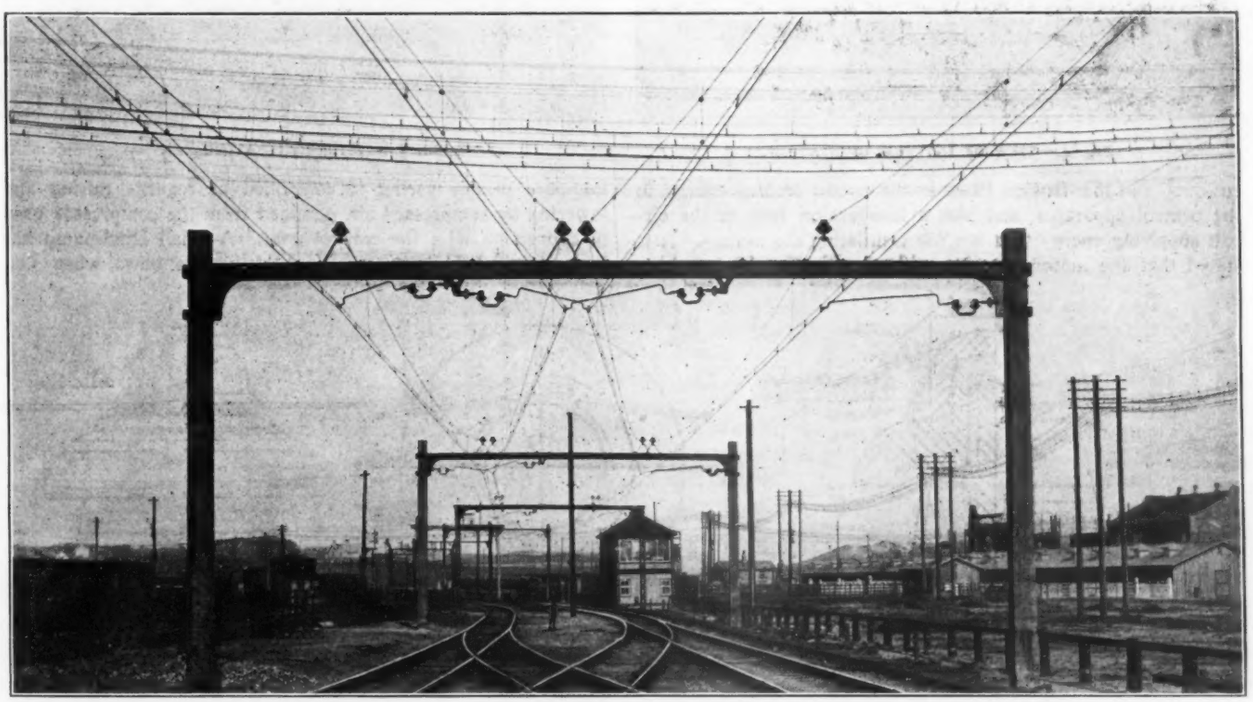


FIG. 2.—GENERAL VIEW OF OVERHEAD ARRANGEMENT USED AT CROSSOVERS.

GENERATING EQUIPMENT.

The motor-generators receive energy from direct-current generators which are driven by gas engines. Originally the station, which was provided for supplying energy to lamps, cranes, capstans, elevators and other machinery at Heysham Harbor, contained three 250-hp, three-cylinder British Westinghouse engines driving 150-kw generators. There was also in use a storage battery rated at 100 × 5 kw-hours, which was employed in conjunction with a British Westinghouse booster for carrying the peak of the loads. In connection with the traction scheme there has been added a Westinghouse engine and generator rated at 235 kw, and a Lancashire battery and booster for handling a maximum of 1000 amp.

ROLLING STOCK.

The rolling stock consists of three trains, each consisting of a motor car and one or more trailers. The equipments for two of the motor cars were supplied by Siemens Brothers; that for the other was furnished by the Westinghouse Company. Each end of the trailers and of the motor cars is provided with controlling apparatus, so that the trains can be operated in any de-

sired direction. The control apparatus is arranged for multiple-unit connections; that on the Westinghouse car is electro-pneumatically operated, while that on the Siemens cars is electric throughout.

Each motor car is equipped with two 25-cycle, single-phase motors. Each of the Siemens motors is rated at 180 hp; the Westinghouse motor is rated at 150 hp. The auxiliary apparatus on the Siemens cars consist of the main transformer, a lighting transformer, a so-called "preventive" coil and commutating transformer, high-tension circuit-breaker and fuse in the main transformer circuit, high-tension fuse in the lighting transformer circuit, contactors, motor fuses which also act as motor cut-outs, and low-tension fuses in the circuit feeding energy to the control apparatus, and also a low-tension fuse in the circuit supplying energy to a fan for ventilating the motors. It is stated that the motors operate without objectionable sparking or excessive temperature rise at 2½ times the rated full-load torque.

The auxiliary apparatus on the Westinghouse car comprises the main transformer, a lighting transformer, a so-called "preventive" coil, a high-tension circuit-breaker in the main circuit, fuses in the auxiliary high-tension and low-tension circuits, contactors and control gear. The motors are ordinary conductively-compensated series machines without any special commutating device other than the commutator resistance leads, the equipment as a whole being very simple and effective. The commutating performance on the line of these motors is excellent, and also as good as, if not better than, that of an ordinary large direct-current traction motor, while the commutator remains in quite as good running condition as that of any such motor.

Each of the Siemens cars is provided with two collector bows; there is a small auxiliary bow at the end controlled by parallel-motion devices. The Westinghouse bow is of the standard pantograph type, only one bow being used on the car. Both forms of bows are purely spring controlled. However, the Siemens bow is lowered by a master spring which can be thrown out of action by a vacuum cylinder. The Westinghouse master spring is controlled as regards raising and lowering by compressed air, obtained from the compressor used in connection with the control gear. A small hand-pump has been installed in each case for raising the bows when first starting out in the morning, or at similar times when no compressed air or vacuum is available. All of the "live" portions of the collector gear in each case are carried on porcelain insulators.

It may be mentioned in connection with the collector gear that the roofs of all the coaches have been covered with a "grounded" wire-netting, so as to throw out the station circuit-breakers in the event of the overhead wire coming down on the roof. The efficacy of this has been actually and satisfactorily tested in practice.

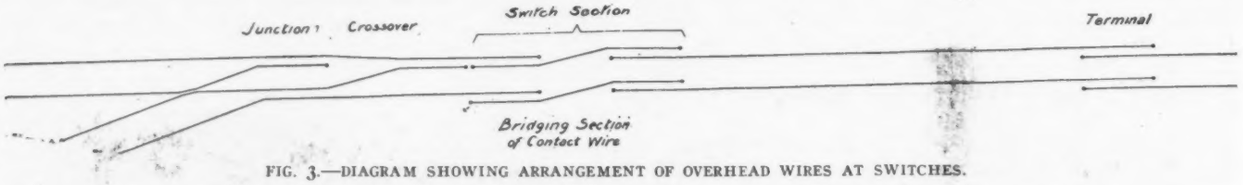


FIG. 3.—DIAGRAM SHOWING ARRANGEMENT OF OVERHEAD WIRES AT SWITCHES.

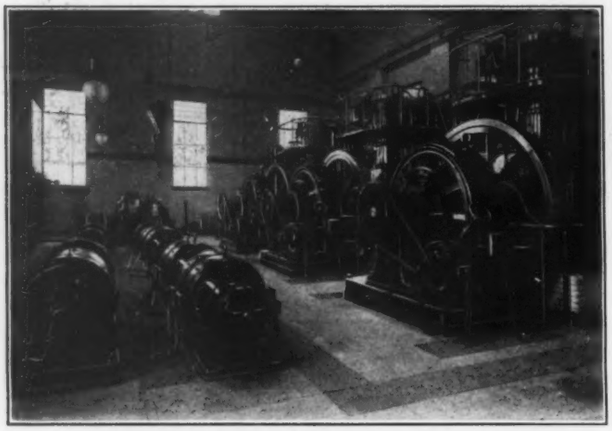


FIG. 4.—VIEW OF INTERIOR OF STATION.

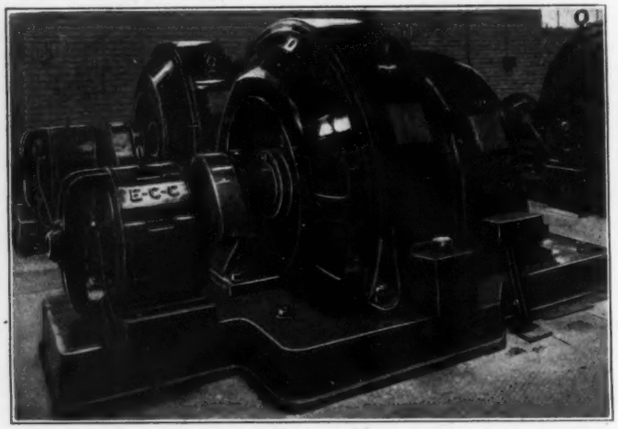


FIG. 5.—MOTOR-GENERATING SET.

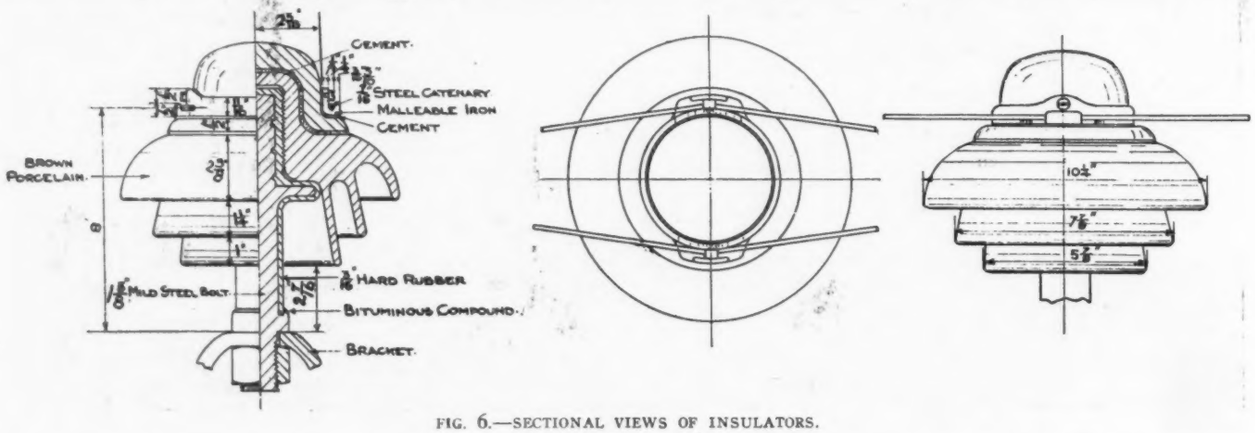


FIG. 6.—SECTIONAL VIEWS OF INSULATORS.

The performance of the motors of these three cars in actual service suffices to disprove the assertion made against single-phase motors of excessive and injurious sparking. It may also be mentioned that in a test with a two-car train weighing approximately 58 tons, made incidentally in the course of ordinary running, one of the Siemens cars attained speeds of 30 miles per hour in 41 seconds, and 48 miles per hour in 80 seconds, and the free running speed of 60 miles per hour in 160 seconds, starting and running for 440 yards after starting, on an up-grade of 1 in 200, there being, however, thereafter about 100 yards of level, and then a down-grade of 1 in 500 for 1½ miles.

The general scheme for the electrification, the equipment of the generating station, and the driving equipment of the rolling

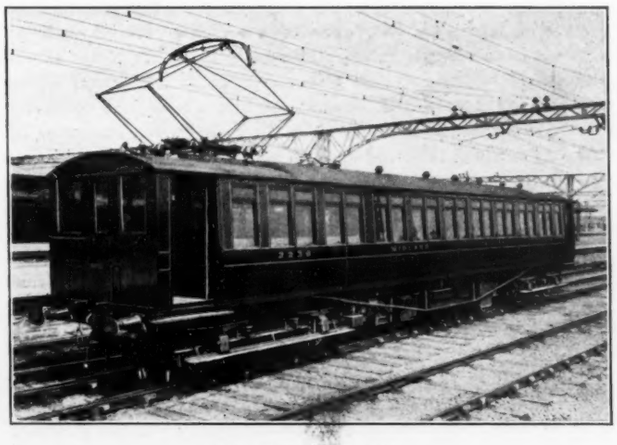


FIG. 7.—MOTOR CAR.

stock were planned by Mr. R. M. Deeley, locomotive superintendent of the Midland Railway Company, and his assistant, Mr. J. Dalziel. The cars were built according to the designs of Mr. D. Bain, rolling stock superintendent of the Midland Railway Company, who has been assisted by Mr. P. Ellis, the chief draughtsman of the rolling stock department. The overhead trolley construction was designed by and installed under the direction of Mr. W. B. Worthington, chief engineer of the Midland Railway Company, by Mr. J. Sayers, the telegraph engineer of the company, and by Mr. Argyle, the northern divisional engineer.

Single-Phase Motors.

An article on commutation and on the effects of voltage variations on single-phase traction motors, by Mr. W. Reichel, was published in a recent number of London *Electircal Engineering*. These are the two weak points, in the opinion of the author, of the single-phase motor compared with the direct-current motor. The author says that the commutators of the single-phase motors still need constant attention, and not only are the costs of supervision thus increased, but the commutators themselves have to be changed much more frequently than is the case with continuous-current motors. To improve commutation the author recommends to use a lower frequency than usual, say 15 periods, which has also other advantages. An increase in the capacity of the motor for a given weight and a better power-factor are also obtained, and the latter improvement renders the use of a larger air gap possible between rotor and stator. Above all, the inductive drop in the transmission line and the extra resistance (due to the skin-effect) of the rails are very considerably reduced. In the face of these advantages, the influence of a reduction of the frequency on the generators and transformers does not seem to be so important. With respect to the effect of variation of voltage the author quotes some tests with Winter-Eichberg motors to show that single-phase motors are in this respect practically as satisfactory as direct-current motors.

A. I. E. E. Papers on Electrical Machinery.

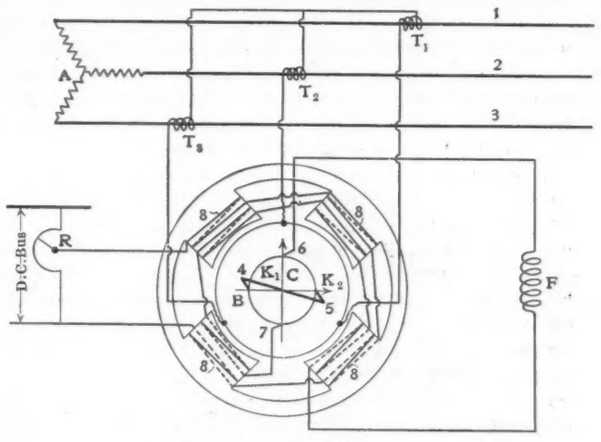
Our issue for last week contained a brief account of the opening session of the annual convention held at Atlantic City, June 29 to July 2. A note relating to the remaining sessions is given elsewhere in this issue. During the session on Monday morning much interest was manifested in the presentation and discussion of papers dealing with synchronous converters and alternating-current generators, abstracts of which are given below.

THE SPLIT-POLE SYNCHRONOUS CONVERTER.

Prof. Comfort A. Adams read a paper dealing with the voltage ratio in split-pole synchronous converters, in which he explained why the field distortion required for voltage regulation does not necessarily involve electromotive force distortion, a subject which caused considerable discussion at the February meeting of the Institute. The author explained the relation between the single-conductor e.m.f. and the flux distribution, and found by summation the resultant voltages at the commutator and at the collector rings, and expressed the relation between these two e.m.f's. in the form of an equation. The change in the conversion ratio is attributable to the presence of higher harmonics in the waves of the single-conductor e.m.f. The resultant collector-ring e.m.f. may be devoid of certain harmonics due to their cancellation by algebraic addition within the winding. Between collector rings separated by 120 electrical space degrees the third, ninth, fifteenth, etc., harmonics of the single-conductor e.m.f. do not appear in the resultant, and there will be no corresponding harmonic currents set up. Even with 180 deg. separation between rings there will be no harmonic e.m.f's. or currents of these frequencies in a six-phase diametrically-connected converter, provided the primaries of the step-down transformers are joined in star.

STORAGE BATTERIES IN ALTERNATING-CURRENT SYSTEMS.

A paper by Mr. J. L. Woodbridge gave an outline of the various methods which have been adopted or suggested for applying storage batteries to the regulation of loads on alternating-current systems. Among the equipments described may



BOOSTER FIELD-REGULATING GENERATOR.

be mentioned the 275-cell, 1920 × 1-amp-hour battery used by Spokane & Inland Railway Company as a load equalizer for its single-phase railway. The battery is connected to the three-phase supply system through a split-pole synchronous converter. Another application of the split-pole converter in connection with a storage battery will be found at Gary, Ind., where a 2200-kw converter is to be connected to a 125-cell, 4320 × 1 amp-hour battery to be used for relieving the alternating-current supply circuits from load variations. The converter provides a commutator e.m.f. range from a minimum of 200 to a maximum of 300 volts.

A special alternating-direct-current exciter will be used for varying the voltage of the converter. The exciter consists of a bipolar armature revolving in a field frame having four pro-

jecting field cores, although magnetically bipolar. The armature is connected by suitable collector-rings to the secondary windings of three series transformers whose primaries are the main three-phase supply lines. The alternating current in the armature winding would, if the latter were stationary, produce a revolving field having a value proportional to the load on the supply lines. However, the armature is rotated by means of a synchronous motor in a direction opposite to that of the field rotation, so that the field remains stationary in space. The stationary field has an axis in line with the arrow K_1 of the accompanying illustration. A commutator, C, is connected to the armature winding upon which bear two pairs of brushes, 4-5 and 6-7. The effect of the field K_1 would be to produce a direct electromotive force between the brushes 4 and 5. A shunt winding, 8, on the four poles of this machine, controlled by the rheostat R may be adjusted to neutralize the field K_1 at any predetermined output from the source A, thus reducing the electromotive force between the brushes 4 and 5 to zero. These latter brushes are short-circuited.

If a slight increase of load on the source A should occur the field K_1 would no longer be neutralized by the shunt field winding and an electromotive force would be produced between the brushes 4-5, causing a considerable current between these brushes. This current produces a secondary field K_2 at right angles to the first and of appreciable magnitude; and this second field produces an electromotive force across the other pair of brushes 6-7, which are connected to the regulating field-coil F. In series between the brush 7 and the corresponding terminal of the field-coil F is connected a series winding on the poles of the exciter, designed to neutralize the magnetomotive force of the current through the armature winding between the brushes 6 and 7, so that the output from these brushes will have no disturbing effect on the exciter field magnetism.

The author stated that this type of exciter possesses a number of important features in connection with alternating-current regulation, which may be briefly enumerated as follows:

1. It acts as a multiplying device by reason of the magnifying effect of the current between the short-circuited brushes, and can therefore be made exceedingly sensitive to small changes in the alternating-current load.

2. It can be made to respond to any desired phase component of the alternating current by a suitable angular relation between the exciter armature and the armature of the synchronous motor which drives it. Thus for controlling the charge and discharge of a storage battery this exciter would be adjusted to respond to the power component of the alternating current.

3. For controlling the power factor on the alternating-current circuit the two pairs of brushes 4-5 and 6-7 may be interchanged so that the latter are short-circuited while the former are connected to a field winding on any synchronous apparatus connected to the alternating-current circuit. The exciter will then be responsive to the wattless component of the alternating current and can be made to control the field magnetism of the synchronous apparatus in such a way that this apparatus will supply practically all or any desired proportion of this wattless current. For controlling both the power fluctuations and the power-factor two such exciters may be operated, one of which is responsive to the power component and the other to the wattless component of the current.

Another advantageous feature of this exciter lies in the fact that the secondaries of the series transformers may be short-circuited at any time with the result of merely "killing" the regulating function. It is not necessary to disconnect the leads to the collector-rings before doing this, even with considerable excitation in the shunt field winding of the exciter, since the armature reaction is so great that a short-circuit will produce only a nominal current sufficient to demagnetize the fields. Similarly, in putting the apparatus into service the rheostat R, if properly calibrated, may be set for any desired constant load on the source A, and after all the main connections are closed so that the battery is merely "floating" on the system, the short-circuiting switch across the secondaries of the series transformers may be opened and the load on the source A will immediately be held at the constant predetermined value for which the rheostat R has been set.

DISCUSSION.

The discussion on the papers by Professor Adams and Mr. Woodbridge was opened by Mr. Paul M. Lincoln, who explained in detail the characteristics of the split-pole converter. He admitted that by properly placing the alternating-current taps it is possible to eliminate certain of the higher harmonics in the electromotive force wave. Moreover, by properly interconnecting three transformers in star, currents of triple frequency can be eliminated from the supply system. However, in the latter event the neutral point of the three transformers cannot be used for connection to the middle wire of a three-wire direct-current system because the e.m.f. of this point is not stable. In comparison with a converter of the usual design the use of split poles will represent a decrease of from 25 to 30 per cent in the output rating. This estimate refers to the three-part pole. In the two-part pole converter the reduction would be about 20 per cent. It is probable that a split-pole converter possesses a greater tendency to spark than does a converter of ordinary design. Furthermore, a split-pole converter will cost equally as much as, or more than, an ordinary converter with its usual array of auxiliary apparatus, while the efficiency would be no better. It is doubtful whether the split-pole converter will run noiselessly. It will be unable to change its electromotive force with great rapidity. It seems, therefore, that this machine possesses no advantages over the standard synchronous converter with a booster mounted on a common shaft.

Mr. W. L. Waters remarked that Mr. Woodbridge had discussed the split-pole converter in connection with storage batteries. In order to obtain the desirable characteristics which equipments described by Mr. Woodbridge may possess, it would be necessary to expend considerable money in batteries and auxiliary apparatus. The multiplication of the number of links in the chain of apparatus connecting the supply system to the consuming devices is objectionable. However, the equipments proposed by Mr. Woodbridge possess characteristics which render them desirable for use in system where energy is purchased on a maximum demands basis, because the peaks can easily be suppressed. Mr. Waters explained that local currents may be produced in the armature of the split-pole converter when the machine is out of balance or the various field poles are not similar to each other.

Dr. C. P. Steinmetz by means of simple diagrams explained in an instructive manner the characteristics of the split-pole converter which allowed the ratio of the collector-ring voltage to the commutator voltage to be changed as desired. He stated that in a converter of ordinary design the commutator voltage can be varied from its maximum to zero, by merely shifting the brushes with the field stationary, or by shifting the field magnetism, the brushes remaining stationary. The change in the position of the field magnetism with stationary brushes can easily be produced by electrical means. Thus each field-pole can be divided into several parts and the magnetism in these parts can be varied as desired, thus shifting the effective magnetism with reference to the position of the brushes. This shifting explains at once the change in the commutator voltage obtained with the split-pole converter. However, with the simple arrangement assumed above, sparking would be produced at the brushes, and provision must be made for preventing such sparking. As actually constructed there is left a neutral magnetic zone where the brush is located so that even when the effective field magnetism is varied considerably, the magnetism under the brush remains small in value, although having the proper direction to render commutation satisfactory. It is not proper to neglect the fact that the direct-current armature reaction in a split-pole converter does not always neutralize the alternating-current armature reaction of the machine. For example, in the usual synchronous converter the commutator voltage is 40 per cent larger than the diametrical collector-ring voltage, and under this condition the direct-current armature reaction counterbalances the alternating-current armature magnetomotive force. When the commutator voltage is varied,

while the collector-ring voltage remains constant the ration between the direct-current armature reaction and the alternating-current armature reaction is varied accordingly, because an increase in the commutator voltage means a relative decrease in the direct-current while a decrease has the opposite effect. To the change in the voltage can be contributed a large portion of the increase in the material required for constructing a variable-voltage machine. The full output rating of such a machine must be obtained with maximum voltage, combined with the minimum current and with minimum voltage taken with maximum current. Thus the machine must be able to produce maximum voltage and maximum current, and hence under any condition must require the amount of material necessary to construct a machine rated at the product of these two maximum factors.

After the authors had closed the discussion on the above papers three papers devoted to alternating-current generators were presented. On Thursday morning the paper by Mr. Carl J. Fechheimer, abstracted below, was read by the author.

LARGE GENERATOR FOR NIAGARA FALLS.

A paper by Mr. B. A. Behrend described a 12,000-volt, three-phase, 25-cycle alternator rated at 6500 kw recently built for the Niagara Falls Hydraulic Power & Manufacturing Company, which is remarkable on account of its high speed of 300 r.p.m. The generator was designed to be safe at the runaway speed of the turbine, 506 r.p.m. A disk of nickel-steel without a hole in the center forms the middle part of the revolving element. Two nickel-steel rings are mounted on each side of this web and are bolted and keyed to it. The nickel-steel has an ultimate strength of 80,000 lb. per square inch and is of high magnetic permeability; it contains 3.5 per cent of nickel. The weight of the complete rotor is only 92,900 lb. The weight of the stator is 116,700 lb. and the weight of the entire machine is 275,000 lb. The full-load efficiency at 90 per cent power-factor guaranteed was 96 per cent; the efficiency under test was found to be 97.66 per cent. The regulation is 8.4 per cent at full-load and unity power-factor at 12,000 volts. The machine has 10 poles and 120 armature slots. The rotor diameter is 126¾ in.; the diameter of the bore of the armature is 130 in.

MODERN DEVELOPMENT IN SINGLE-PHASE GENERATORS.

A paper by Mr. W. L. Waters was devoted to a discussion of the methods employed to overcome the difficulties encountered in building large low-frequency single-phase generators. The difficulties are attributable to the excessive pole-pitch which involves great losses in the pole faces by reason of the pulsating armature magnetomotive force and tremendous mechanical stresses on the end-connections of the armature under short-circuit conditions. In explaining the action of the pulsating armature m.m.f., the author considered the single-phase alternating m.m.f. to consist of two rotating m.m.f. each of one-half the maximum value, one rotating at the same speed and in the same direction as the generator field magnet, and the other rotating at the same speed but in the opposite direction. The m.m.f. rotating synchronously with the field magnet causes very little loss, but the one rotating in the other direction causes losses throughout the whole magnetic circuit due to hysteresis and eddy-currents produced by the change in flux. Reports of tests were given to show that in certain two-pole, 25-cycle, single-phase generators the loss was 3.5 per cent, causing a temperature rise of 125 deg. C. When "dampers" were placed on the poles the loss was reduced to 0.5 per cent and the temperature rise to 30 deg. C. The damper system acts in regard to the reverse rotating m.m.f. in the same way as a short-circuited secondary, the current produced in the damper minimizing the field which the m.m.f. tends to form. As showing the stresses to which the end-connections may be subjected, the author stated that a certain 6000-kw, two-pole, 25-cycle, single-phase generator having a pole pitch of 100 in. would experience a force of about 10,000 lb. on the end connection of one coil during a short circuit. To withstand such great forces there has been devised a bronze coil support of heavy girder-section, which has proved successful in actual operation on machines rated at as high as 10,000 kw. The author claimed that at the present time single-phase turbo-generators for 15 or 25 cycles can be, and are, built with the same success as that obtained on standard low-speed polyphase generators.

FRACTIONAL-PITCH WINDINGS FOR ALTERNATING-CURRENT GENERATORS.

A paper by Mr. Jens Bache-Wiig discussed the advantages of using fractional-pitch rather than full-pitch windings on alternating-current generators. When a fractional-pitch winding is substituted for a full-pitch winding there is a small decrease in the generated e.m.f., but a proportionately large decrease in the amount of copper required, so that by slightly increasing the number of turns to compensate for the decrease in e.m.f. the initial output may be maintained with a net reduction in amount of active material required. Five additional reasons for the use of fractional-pitch windings are given by the author, namely, to obtain the proper number of turns in certain cases, to enable former-wound coils to be used in generators of small bore and few poles, to reduce the space occupied by the end-connection to improve the ventilation, and to save insulation.

PROPORTIONS OF COPPER AND IRON IN ALTERNATORS.

Mr. Carl J. Fechheimer presented a paper describing a method developed for enabling a designer to determine easily what value of flux to employ in the field magnets of an alternator in order that the cost of the machine may reach a minimum. The treatment is based on a mathematical analysis of the costs of the several parts of the machine as affected by the relative proportion of copper and iron. Equations are derived for the weights of the principal parts of the alternator, the weight in each case being expressed as some factor which is easily determined, multiplied by some power of the flux per pole. The weight of these parts is then multiplied by the price per pound of material used and some other factor to allow for the unavoidable scrap material, and also for some of the parts not included in the equations, as, for example, the stator teeth and the spider arms. The sum of these costs will give the cost of the material in the principal parts of the machine expressed in terms of the flux. He then finds what value of flux to employ to give the minimum cost of material in the parts considered by differentiating the equation obtained with respect to the flux, equating to zero, and solving the equation for the flux. Having determined the flux, the number of conductors necessary to give the desired e.m.f. at once follows. The arrangement of these conductors, the diameter and length of the machine, the dimensions of the field conductor, etc., are, of course, left to the judgment of the designer. The constants given by the author relate to revolving-field alternators having rectangular poles.

DISCUSSION.

Mr. D. B. Rushmore explained that although many purchasers of alternating-current generators seem not to appreciate the fact, it is undesirable for an alternator to possess too close voltage regulation, because the abnormal current produced on short circuit proves disadvantageous. In this respect it should be recognized that the instantaneous short-circuit current of the alternator is always much greater than the current obtained by the short-circuit in the armature by slowly increasing the field magnetism to normal value. In the event of the instantaneous short circuit at normal e.m.f. the current is limited only by the local magnetic leakage reactance of the armature winding, the magnetomotive force of the armature current having a negligible instantaneous de-magnetizing effect on the field. One of the tests to which an alternator designed for direct-connection to water-wheels must be subjected is that of over-speed. Although this test is of great importance, information relating to the proper value of the over-speed of water-wheels is very limited. The theoretical maximum is 100 per cent above the normal running speed of the wheel. However, this value is seldom used, 75 per cent being frequently assumed.

Mr. L. Schuler in discussing Mr. Waters' paper stated that experience has proved low resistance dampers to be excellent for preventing hysteresis and eddy-current losses in the magnetic circuits of single-phase generators.

Dr. C. P. Steinmetz explained a method, involving the use of a reactance coil, by means of which the currents in the three circuits of a three-phase generator may be kept balanced when the machine is loaded as a single-phase generator. The reactance coil is connected across between the inactive phase lead and one of the active leads, the connection being such that the current in the reactance coil is 120 electrical time degrees out of phase with that in the load circuit of the machine. Thus the combined currents taken by the reactance coil and the load require symmetrically disposed and equal currents in the three windings of the machine, and therefore the armature magnetomotive forces produce a field of constant strength revolving synchronously in the negative direction just as though the machine carried a true polyphase load. Moreover, on account of the energy stored in the coil during half cycle and returned to the system during the other half, the torque on the machine is constant, and the load on the prime-mover does not fluctuate. The latter characteristics should prove advantageous for low-frequency machines, especially those of 15 and 10 cycles, if such machines are ever built.

Mr. W. L. Waters stated his belief that certain of the proportions of the machine described by Mr. Behrend had not been well selected because the stresses were not properly distributed. In discussing Mr. Fechheimer's paper Mr. Waters stated that the method proposed by the author is more of academic interest than of engineering importance. In the design of alternators it is absolutely essential to depend upon experience for the constant, and it is far preferable to resort to the trial-and-error method rather than to use a general solution such as outlined by Mr. Fechheimer.

Prof. C. A. Adams remarked that Mr. Fechheimer's method should be of assistance in reducing the amount of labor required in selecting the proportions when designing machines of new types.

The following papers dealing with induction motors were presented in abstract:

INDUCTION MOTORS IN CASCADE.

The operation of two induction motors connected in direct and differential concatenation and as single machines in order to obtain variable speed was discussed in a paper by Mr. H. C. Specht. Two 60-cycle motors, one having 10 poles and the other 6 poles, have a synchronous speed of 450 r.p.m. when arranged in direct concatenation, a speed of 720 when one motor is used alone, a speed of 1200 when the other is used, and a speed of 1800 r.p.m. when the machines are connected in differential concatenation. The disadvantages of a cascade set are its lower power-factor and efficiency compared with two independent motors for the same duty, while its advantages are greater latitude in design, a more flexible and simpler speed control and safer operation. The change from low speed to high speed can be made gradually without causing any mechanical jarring or electrical disturbance, by inserting high resistance across the circuits interconnecting the two motors and decreasing the resistance gradually with increase in speed until the rotor reaches the normal speed of the leading motor.

MAGNETIC FIELD IN POLYPHASE INDUCTION MOTORS.

Mr. R. E. Hellmund presented a paper describing graphical diagrams for studying the phenomena of the revolving field in a polyphase induction motor. He found that with the secondary on open-circuit the field is not sinusoidal in space distribution and individual parts of the field rotate at non-uniform speed. Moreover, the total flux is less than would be required if the field were sinusoidally distributed and traveled at uniform speed. When the secondary is closed high-frequency currents are produced therein at synchronous speed, tending to give to the resultant field a sinusoidal space distribution, while the primary current is increased by reason of the presence of the secondary current, which attempts initially to give a merely sinusoidal distribution to a flux that is lower than demanded by the required counter e.m.f. The author showed that the increase in the no-load current is greater in the case of a two-phase than of a three-phase motor having the same total number of slots per pole.

DISCUSSION.

The discussion on Mr. Specht's paper was opened by Mr. W. I. Slichter, who explained that when two motors are connected in cascade for railway work the starting torque of the combination is no greater than that of one of the motors used alone.

Mr. A. E. Averrett said that although the use of motors in cascade allows the efficiency to be maintained at a certain lower speed, yet the effective speed range is quite limited. The combination is disadvantageous in possessing a low power factor.

In reply to a question by Mr. E. A. Sperry, Mr. Specht stated that the cascade set is well adapted to the return of energy to the line when running above any one of its several synchronous speeds. He showed several diagrams of schemes that have been proposed for overcoming the one great disadvantage of the cascade set, namely, its low power factor. The schemes involve the use of commutating machinery for lowering the frequency of the exciting current and thereby supplying the magnetomotive force without requiring wattless currents.

In discussing Mr. Hellmund's paper, Prof. C. A. Adams remarked that graphical methods, such as those used by the author, are especially advantageous in affording a pictorial representation of the physical phenomena, and thereby allowing a student or designer to obtain a correct conception of the inter-relations.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Electric Refrigeration in a Florist's Shop.

By R. L. Lloyd.

Early last year the proprietors of one of the best of Philadelphia's florist shops decided to adopt mechanical refrigeration. They had a very handsome display case along the east wall of their establishment, 16½ ft. long, 9 ft. high and 42 in. wide, embracing about 500 cu. ft. It consisted of a show case with three shelves, drawers below and an ice bunker above (see Fig. 1). Formerly the four sliding doors had double panes of glass, but the view of the flowers was interfered with, and so this was changed to a single thickness of beveled plate glass. As the proprietors remarked, they were "willing to sacrifice economy for appearance." The shelves held jars and vases of cut flowers in water, and were usually kept full at all times, 40 jars holding probably 200 lb. or 300 lb. of water as an average quantity, and this was renewed daily. Four 16-cp electric lamps were kept burning in the case above and in front, so as to properly illuminate the roses, etc., but not seen by the observer. The drawers below contained the smilax and green stuff and were well filled. Openings in the floor of the main case permitted the coldest air to circulate down to and around these goods. Both doors and drawers were opened frequently, averaging probably four times per hour each.

Under these conditions it was found necessary to use 500 lb. to 700 lb. of ice each day to maintain a temperature of 44 deg. or 45 deg. The annoyance and inconvenience of handling were great. The ice bill for one year was $501.

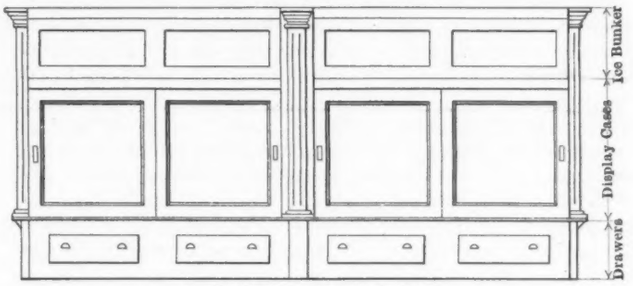
It was contended that the cost of electric energy to operate a refrigerating machine to produce equal results should not be much over half this amount.

A contract was made for a Brunswick refrigerating machine of one ton capacity, which was guaranteed to produce the desired results.

The cost for the complete installation in operating condition

was a little above $1,000. The installation was completed and the machine operating the last week in May, 1907.

In the ice bunker above the cases four narrow brine tanks, 14 ft. 9 in. long, 18 in. high and 4 in. wide, were placed, and the ammonia expansion pipes led into them. Each tank was cooled by 100 ft. of 1-in. pipe, bent zigzag and arranged in seven rows each 14 ft. long. One barrel, or 350 lb., of calcium chloride salt was dissolved in enough water to fill these four tanks, making a weak solution, Sp. gr. 1.05, with a freezing point just below



REFRIGERATED DISPLAY CASE.

26 deg. Fahr. The idea was to freeze this solid and have a result similar to that obtained with ice.

It works out admirably in practice. At eight in the morning, when the store is opened, the machine is started in operation. The temperature in the cases at this time is found to be just about as it was left the night before, around 45 deg. The water in the vases and jars is then renewed and fresh flowers put in from the hot house. The doors are opened constantly for quite a while, and the temperature rises in the cases sometimes as high as 60 deg. This will naturally vary at the different seasons of the year, depending upon the temperature of the room and the water supply. The cases are soon brought down to the desired temperature, and toward evening the tanks will have frozen solid again. The machine is then stopped and remains so over night, and generally over Sunday. Once or twice, under exceptional conditions, it has been found desirable to run a short time on that day.

The results have been very satisfactory, and the avoidance of the bother and trouble of handling ice is in itself justification for making the change. There have been no break-downs or repairs to interrupt the service, but there is a balance on the profit side of the ledger in addition. The proprietors have ordered that the machine be overhauled every year, a preventive measure.

This is the way the account stands for the first year:

Cost of electric power	$301.07
Overhauling and new oil	10.00
Interest at 5 per cent	52.00
Depreciation at 10 per cent	104.00
	$467.07
As compared to ice	501.00
Saving	$34.00

There are no depreciation charges here shown against the use of ice. Undoubtedly there should be, for every one who has had experience in getting in ice daily in large quantities knows how the cases and refrigerator boxes are sure to be bumped, scratched and broken. Also 10 per cent depreciation against the whole cost of installation has been allowed, including motor and wiring. This is very liberal and should no doubt be reduced.

The motor used is a 3-hp Fort Wayne 220-volt, direct current. A test shows it to be taking about 2 kw as a steady input. It is belted direct to the driving pulley of the machine, which runs at 280 r.p.m.

Particular attention is called to the doors of this case. They are sliding, in preference to hinged doors. Sliding doors, if they are to open easily, cannot be very tight, and this is a great disadvantage usually on refrigerators. In this case, however, where the difference in temperature between inside and outside of the cases is not so great, the sliding doors are preferable. Every time a swinging doorway is opened, the separating wall to the full size of the doorway is removed, and in addition a suction is created which draws a large volume of the cooled air out of the enclosed space. Where the doors are to be opened frequently this is a large item and a severe drain on the cooling system. In this instance the sliding door can frequently be moved a foot or so and allow ample opening for the removal of flowers. The disadvantage of looseness around the door casings is more than made up by the other advantages.

Tungsten Lamps in Budapest.

A recent canvass by the General Electric Company, of Budapest, Hungary, which supplies alternating current, showed that there are about 15,000 tungsten lamps installed on its lighting circuits, and it is estimated that the same number is in use on the circuits of the other company supplying lighting service in that city by direct current, the total thus being about 30,000 tungsten lamps of various candle power. A practice has grown up whereby tungsten lamps are rented by makers and lamp dealers to large customers, on the basis of 0.16 cent per lamp-hour. The lessee installs at his own expense a secondary meter, and from the kw-hours recorded the monthly rental is determined. Lamps supplied on the rental basis are replaced, when they break, free of charge.

INTERIOR WIRING AND ILLUMINATION

Helps in Rapid Preliminary Calculation of Illumination.

By J. R. Cravath and V. R. Lansingh.

In the first few years of its existence the art of illuminating engineering has had to depend for its calculations of illumination made in advance of the installation on the laborious method of figuring the foot-candle intensity point by point over the area under consideration. This method does not give the true average foot-candles unless the foot-candles are calculated for a sufficient number of equally spaced points over a section of room large enough so that the average of these points represents the true average of the room. The ordinary method of taking the illumination at different typical points and averaging them does not give the true average in most cases. Furthermore, such calculations have not taken into account the increase in illumination due to reflection from ceilings and walls.

Tests of the actual illumination produced in various installations, if properly measured with an illuminometer or portable photometer, are more satisfactory and more easily applied foundations for preliminary calculations of illumination than the point by point method.

There have been made in the past two years sufficient reliable tests of the illumination of actual installation so that it is possible to predict results for a considerable number of given conditions. The authors have compiled from various sources the table given herewith which shows the watts per square foot received to produce an average illumination of one foot-candle on a plane about 30 in. from the floor in various large rooms with various electric lighting equipment. This is the numerical equivalent of watts per lumen.

In compiling this table the attempt has been made to give figures which will represent average conditions with lamps and reflectors reasonably clean and lamps within 10 per cent of rated candle-power. Such favorable conditions frequently do not exist due to dirt, blackened lamps or low voltage. The figures in the tables are mainly derived from measurements in large rooms reported in the *Transactions* of the Illuminating Enginering Society and the Association of the Edison Illuminating Companies, and also tests by the authors. The uniformity of illumination (that is, the difference between the maximum and minimum) will depend, of course, on the number and spacing of the lamps

and the distribution of light from each lamp; that is, whether concentrated or distributed.

The practical application of this table will be shown by the following examples:

Suppose we wish to light a large store 50 ft. wide by 100 ft. long, having 5000 sq. ft. of floor area, with light ceilings and dark walls. We wish to obtain an average illumination of 3 foot-candles on the counter level. Looking at the table we see that if we use tungsten lamps with prismatic bowl reflectors 1 foot-candle will require 0.25 watt per square foot. Practical experience has also demonstrated that with units spaced apart not more than two times their height above the plane illuminated the illumination will be very uniform in such a case. It will, therefore, take 5000 sq. ft. × 0.75, or 3750 watts to illuminate the room in this way. If 100-watt lamps are used, 38 would be needed. Four rows of nine each would take 36 lamps. Other combinations can, of course, be worked out.

For another example, suppose a large general office room, 40 ft. x 40 ft., area 1600 sq. ft., which we wish to illuminate with an average intensity of 4 foot-candles with Nernst single-glower 110-watt lamps. Looking at the table we see that 1 foot-candle with such lamp equipment requires 0.5 watt per square foot. Multiplying 0.5 by 4 foot-candles gives 2 watts per square foot. For 1600 sq. ft., therefore, two times this or 3200 watts would be required. Twenty-nine 110-watt lamps will serve the purpose. Five rows of six each, or 30, would probably be the best arrangement to adopt for reasons of symmetry.

The simple rule for the application of this table is as follows: Total watts = area room × foot-candles × constant from table.

TABLE SHOWING NUMBER OF WATTS PER SQUARE FOOT OF FLOOR AREA REQUIRED TO PRODUCE AN AVERAGE OF 1 FOOT CANDLE OF ILLUMINATION. (WATTS PER LUMEN.)

INCANDESCENT LAMPS.	
Tungsten lamps rated at 1.25 watts per horizontal candle power; clear prismatic reflectors, either bowl or concentrating; large room; light ceilings; dark walls; lamps pendant; height 8 to 15 feet....	0.25
Same with very light walls.....	0.20
Tungsten lamps rated at 1.25 watts per horizontal candle power; prismatic bowl reflectors enameled; large room; light ceilings; dark walls; lamps pendant; height 8 to 15 feet.....	0.29
Same with very light walls.....	0.23
Gem lamps rated at 2.5 watts per horizontal candle power; clear prismatic reflectors either concentrating or bowl; large room; light ceiling; dark walls; lamps pendant; height 8 to 15 feet.....	0.55
Same with very light walls.....	0.45
Carbon filament lamps rated at 3.1 watts per horizontal candle power; clear prismatic reflectors either bowl or concentrating; light ceiling; dark walls; large room; lamps pendant; height 8 to 15 feet.....	0.65
Same with very light walls.....	0.55
Bare carbon filament lamps rated at 3.1 watts per horizontal candle power; no reflectors; large room; very light ceiling and walls; height 10 to 14 feet.....0.75 to	1.5
Same; small room; medium walls.....1.25 to	2.0
Carbon filament lamps rated at 3.1 watts per horizontal candle power; opal dome or opal cone reflectors; light ceilings; dark walls; large room; lamps pendant; height 8 to 15 feet.....	0.70
Same with light walls.....	0.60
NERNST LAMPS.	
110-watt, single glower, Nernst lamp, opaline ball globe; no reflectors; large room; light ceiling; medium walls.....	0.50
ARC LAMPS.	
5-ampere, enclosed, direct-current arc on 110-volt circuit; clear inner, opal outer globe; no reflector; large room; height 9 to 14 feet.....	0.50

The Wiring of the Small City.

By W. J. Canada.

The difficulty of securing a standard class of electric interior wiring in the small city has lately brought about a large amount of correspondence in an effort to locate the reason. It seems to be current opinion that the fault is mainly with the low-grade business policy of the local service company, and its apparent desire to connect to any wiring installation, no matter how defective from the standpoint of safety and reliability as to future operation, when an immediate revenue is in sight.

Such difficulties do not uniformly appear, and the small town lighting company is frequently as much alive as the underwriters themselves to the necessity for keeping the wiring of buildings reasonably free from fire hazards as well as other defects. This has been the experience in the Rocky Mountain field, practically without exception. The service companies have evinced a desire and demonstrated a willingness to support standard wiring by all means at their disposal, even where some business must initially be lost.

The territory consists of a good number of cities between 4000 and 15,000 population, scattered over a territory 400 by 100 miles. There are three large cities which are not being considered. About half the smaller cities have some form of city electrical inspection, generally assisted to a considerable extent by the Rocky Mountain Fire Underwriters.

The plan followed has been for the underwriters' representatives, of whom only two are now engaged in electrical inspections, to take up the matter of general wiring improvement with public, contractors and lighting company simultaneously, especially impressing the public with the fact that satisfactory service, permanency of installation and satisfaction of insuring interests are all guaranteed alike by standard methods of wiring. Some rewiring usually follows a campaign, the matter being ordinarily taken up by some commercial body, or by the city government. In all cases, marked improvement in the new installations has followed within a reasonable time.

Two years ago, only scattered cases of standard wiring had appeared in any of these cities, and the average conditions were probably worse than those of the average town of equal size farther east, because of the less experience of the wiremen in the small Western city. To-day a majority of these cities are installing wiring which will compare well with new wiring anywhere, and the defective installations are being rapidly replaced, in some cities several buildings in congested districts being standardized weekly. Service companies willingly co-operate by refusing connection to hazardous installations. Contractors and public alike endeavor to secure permanency equal to other forms of building construction, and inspection by the underwriters is demanded and their expenses of travel paid for, usually by the contractor.

One considerable difficulty, still, is the lack of co-operation by manufacturers, who continue to supply the field with defective materials and fittings. The supply houses are endeavoring to co-operate in their selection and selling, but claim inability to avoid carrying defective material, owing to competition. This matter seems capable of solution, and should be in better condition as present stocks of defective materials are eliminated.

In the Rocky Mountain field, Denver at present furnishes in some ways a poor example. The major demand for unapproved fittings comes from Denver, where a well-equipped and well-paid inspection department fails to check their use from a species of inertia very hard to understand. In many ways Denver is well advanced electrically, with conduit required in all new buildings except single dwellings. But laxity in regular city inspection is responsible for the existence still of much new construction of an unfinished character. Special rulings for individual cases are too frequent, and embarrass the contracting wireman. The rewiring of old defective installations is also obstructed by special city rules, making reconstruction more costly than would be required by the National Electrical Code. As a result, Denver is rather behind the smaller cities of the field in the general conditions of safety in wiring and wiring improvements. The lighting company is very progressive and in most ways aids in securing safe wiring, but it cannot undertake to advise the city inspection department as to approval of either material or manner of installation, beyond a certain limit. The fact that the service company also owns the gas business somewhat delays the use in Denver of the newer lamps, and the cheaper wiring installations of which they invite.

Taking a group of five cities in northern Colorado, which have many similar interests and whose conditions of building and business are otherwise similar, the improvement in eight months has been such that an average of only 1.3 defects was found in May in 23 new installations. The average of defects was 14.1 in 17 new installations inspected in September of 1907 in these same five cities. The general improvement in illumination has been even greater, more light and better arrangement bringing continually greater demand and better satisfaction with the lighting service.

Gasoline lighting systems, by giving the public a cheap if comparatively unsafe and troublesome light, have replaced some of the old, overloaded and poorly arranged wiring systems in these cities. This change has frequently had its primary cause in a disgruntled frame of the business man's mind, and some lack of tact on the part of the service company's employees. Proper co-operation and attention to the necessities of the business public on the part of underwriters and lighting companies have not only given a check to the use of such systems, but in several cities they are already being rapidly replaced by standard wiring and tungsten clusters, with which both primary cost of installations and subsequent cost of service are considerably lowered and the safety and convenience incomparably improved.

The whole secret is in the exercise of tact and business principles between lighting company, contractors and underwriters, and the public will see the benefit of standard wiring and co-operate also. If either of the above interests—contractors, lighting companies or any commercial body—cannot be induced by proper representations to actively co-operate toward the end of good construction and a gradual removal of dangerous wiring systems in the older buildings, the movement will be checked seriously at every turn. To bring these interests together is the task ordinarily devolving on the underwriters, and while frequently discouraging in any single city, progress is always possible where reasonable prosperity exists. The small city where improvement is at a standstill in wiring is usually moving backward in other ways.

Co-operation Between Central Stations and Contractors.

BY E. F. TWEEDY.

While the relations which exist to-day between the electrical contractor and the central station probably do not differ materially from those which have existed for some few years, yet the public discussion of these relations, among the parties in interest, is a comparatively recent development, and it shows an awakened realization of the possibilities of mutual benefit to be derived from a closer relationship.

As an evidence of the interest which central stations are now taking in this matter, one has but to mention the fact that a number of papers bearing upon this subject have been presented before the National Electric Light Association and before several other organizations within the past two years. The National Electrical Contractors' Association has, on several occasions, given equal evidence of an appreciation of the value of, and of a desire for, a larger amount of co-operation in the electrical field.

In spite of all this, there is, unquestionably, in certain localities at the present time, a feeling of antagonism between the electrical contractors and the central station, which naturally results in the complete absence of any co-operative effort. Where this feeling exists, it can almost invariably be shown to be the result of one general cause, and that is the invasion by the central station of that field which the electrical contractor considers to be his own.

It is stated that about 2300 out of the 5000 central stations in this country sell electrical supplies and perform construction work. In view of this fact that nearly 50 per cent of the total number of central stations in the country are pursuing a course which is largely, if not entirely, responsible for this feeling of antagonism on the part of the contractor it is worth while to examine into the causes which have led to such a large number of central stations to adopt such a policy. While it is true that the number given above is composed for the most part of small central stations, yet it is equally true that several large companies are also included in the number. In extenuation of such a policy, the manager of a small station will generally argue that unless the central station undertakes the installation of wiring and apparatus, at the lowest possible cost to the customer, it will be impossible to secure a satisfactory increase in business. It is usually stated in this connection that the local contractor is not in a position financially to undertake electrical work requiring a considerable outlay of capital, and that he is unable, or unwilling, to employ the most skillful workmen, which results in the work being poorly done, and lastly, that, there being little or no competition on account of the small amount of such work to be done, the price of the work to the consumer will usually be so high as to make it prohibitive. The foregoing arguments are undoubtedly sound in those cases where the central station supplies a town of only a few hundred or a few thousand inhabitants. When a central station serves a larger community, however, one in which there is a sufficient amount of electrical work to provide the necessary incentive for two or more contracting firms to remain in the business and to maintain a satisfactory stock of material and to keep a permanent force of skilled workmen, the arguments given above would seem to have little weight. It is difficult, or impossible, to assign even an approximate figure for the population served, below which a central station would probably be justified in assuming the responsibility which accompanies the doing of construction work and the selling of supplies, but it would appear that a central station which serves a population in excess of 10,000 should be able to free itself from such a responsibility, and that it would obtain a more rapid growth by securing the co-operation of a few local concerns, each one of which could be led to take an active part in developing the territory electrically.

A number of the larger central stations are selling electrical apparatus through their display rooms, and are securing a profit upon each article sufficient in amount to effectively protect the profits of those contractors and dealers who handle light apparatus. There is certainly no just ground for objection to such a policy, and the writer is not aware that any dissatisfaction has arisen from such a course on the part of these central stations. Sales of apparatus are frequently made in this way which would not take place if the callers at the central station display room were referred to some distant point to make the purchase. As the apparatus which is sold in this way generally requires some additional wiring in the purchaser's premises, it is clear that the local contractors secure a direct benefit from such sales.

In what follows, the relations between the central station and the electrical contractor, under the condition which are to be found in a large city, will be briefly reviewed. In considering the electrical contractors, as found in our larger cities, they may conveniently be grouped into four classes, and the relations of each class to the central station are seen to be somewhat different.

The first class to be considered will comprise those contracting or engineering firms whose size and financial resources are such as to enable them to undertake operations requiring a considerable outlay of capital. The activities of this class are frequently not confined to the city in which the main office is located, and they are usually prepared to contract for work in any locality, provided the work is of sufficient magnitude. The electrical work in large office buildings, department stores, hotels, and the like, is usually done by this class. The large size of these installations usually raises the question of the relative cost of supplying energy by means of a private plant in the building and purchasing energy from the central station. This question is usually decided by the owner, upon the recommendations of the consulting engineer or architect, prior to the letting of the contract for the electrical work; in which event the electrical contractor has no opportunity to make any selection or to employ his individual judgment to any extent, as he is simply required to carry out in an intelligent manner certain well-defined specifications. There are many installations undertaken by this class, however, in which the above conditions do not exist, and in which the contractor's recommendations in the matter of private plant versus central station supply may largely influence the decision. It is clear that where the difference in cost between the two methods of supplying energy is not great, and in the absence of other determining features,

a feeling of antagonism toward the central station on the part of the contractor may result in a decision unfavorable to central station supply. It is hardly necessary to point out that such a feeling should never be permitted to exist, and that when it does exist it is to the discredit of the central station management.

The class of electrical contractors next considered comprises those whose operations are on a somewhat smaller scale than those of the class above described. The number of installations contracted for during a given period may be as great, but the size of the individual installation is considerably smaller. This class limits its activity to a single city as a rule and seeks primarily such installations as are afforded by residences, apartment houses, loft buildings, and the better class of stores. The office of a contractor of this class—a portion of which is frequently employed for display purposes—is usually located upon some prominent street. This class often does considerable advertising and it unquestionably promotes, in no small degree, the use of electricity for various purposes.

The third class is similar in some respects to the one just described, but this contractor is to be found in a less prosperous neighborhood, and his work is usually confined to a still smaller class of installation, consisting principally of small stores and the cheaper class of dwellings. A large proportion of the work which is done by this class is obtained through personal solicitation, and many users of electricity are secured in this way who could not be successfully approached by the solicitors of the central station.

The fourth class consists of those individuals who do a considerable amount of electrical work in the aggregate, but who are not electrical contractors in a strict sense of the word, inasmuch as they frequently have some other means of livelihood and only do electrical work on the side. These "grip-sack contractors" not only injure the cause of the central station but bring discredit upon the legitimate electrical contractor. The cheapness of their work appeals to their thoughtless patrons, who little know or care whether the work is done in conformity with the Underwriters' and the municipal requirements. That the aggregate work done by this class is of considerable amount is shown by some figures recently obtained by a central station in a large city. These figures show that during the year 1907 only 20 per cent of those who reported electrical work made over 10 such reports, and that nearly 50 per cent of the total number of persons reporting made only a single report. It is probable, moreover, that a large part of the work which was done by this class was not reported at all. It would appear that a remedy for this condition could be found in the general enactment of state laws requiring the licensing of contractors and the certificating of wiremen. Such a law, if sufficiently drastic, would protect the qualified contractor from unfair competition and would safeguard the users of electricity generally.

While the word "co-operation" has been much abused of late, the need of that for which this word stands is very apparent to-day in the relations between the central station and the electrical contractor. A plan, having for its object the establishment of closer relations with the contractors, could readily be devised; in fact, a number of central stations have already adopted measures intended to bring about this desired result. It may reasonably be expected that such a policy will become more general as the benefits to be derived from such a course become more evident to the great body of electrical contractors and to central station managers as a whole.

The Electrical Contractor and the Central Station.

In the smaller towns the electrical contractor is looked upon as an unpaid solicitor of the electric-light company. In fact, many of the smaller electric-light companies which do not maintain a business-getting department depend upon the local electrical contractors to secure whatever new business is available. In such towns the contractor is known to the electric-light manager and the latter can exercise a directive influence over the former so that undesirable work is not palmed off on an unsuspecting customer and poor service which follows as a natural result be placed at the door of the electric-light company. In larger cities the number of contractors is such as to preclude the possibility of the electric-light manager becoming as well acquainted with the contractor as the manager in smaller towns. The companies in larger cities, however, publish a list of reliable contractors known to them, for the benefit of their patrons. These contractors follow the Code requirements to the letter and good work is the result. The relations between the lighting companies and the contractors are cordial and in some cities, notably Brooklyn, N. Y., the contractors go so far as to notify the company when they are asked to bid on isolated plant work. In the city mentioned the contractors advertise extensively and solicit new work, thereby supplementing the work of the solicitors of the electric-light company. Reports of new business secured are mailed to the electric-light company, which then sends out a solicitor to obtain the signed contract for electrical energy to be supplied.

The Brooklyn Edison Company also gives the contractor the advantage of its experience, etc., in an annual reception and dinner given to the contractors. In the fall it is the intention of the company to form an organization of all persons interested in the electrical field in Brooklyn. Monthly meetings will be held at which electrical conditions will be discussed, the general policy of the company on different questions made known and original ideas promulgated with the intention of fraternalizing all those engaged in the electrical business in the city.

In a few cities the relations existing between the electric-light companies and the contractors are not very cordial; but in a great many cities pleasant relations exist. This is attested in Mr. Becker's paper read before the National Electric Light Association at its last convention, in which conditions in various cities were cited. Speaking of the small contractor, Mr. Becker says he is oftentimes able to reach a class of small shopkeepers who cannot be successfully approached by the central-station's solicitors, and many installations of lamps as well as small motors in the smaller class of stores are directly attributable to the efforts of this class of wiring contractor. He cited a case where by personal solicitation a contractor induced the owner of a factory employed for the manufacture of macaroni to abandon a steam plant of about 100-hp rating and install electric motor drive, using a large number of individual motors supplied with energy from the mains of the electric-light company. The central-station company had made several unsuccessful attempts to bring about this substitution. In another case cited, an owner did not feel that a building he was erecting would attract a class of tenants that would warrant him in incurring the cost of electric wiring. An electrical contractor submitted a plan for wiring the premises cheaply, and the owner was convinced of the wisdom of having the work done.

In view of the fact that contractors are particularly well equipped to solicit business from a certain class of possible central-station customers, Mr. Becker is of the opinion that it would be a wise policy to encourage such solicitation in every possible way. The show room is a factor in displaying various fixtures and appliances and the central station can credit many a sale of energy to the excellent display rooms maintained by contractors. This has become such a factor that many stations make special concessions in the way of free lighting to the contractors maintaining display rooms.

A scheme that was very productive in results for the station was that of a contractor in the South who went to the lighting company and offered to put a solicitor or two out on residence work with a price list for wiring that would apply to all residences, payment to be made in monthly installments for a year without interest. The price list was also supplied to all solicitors employed by the lighting company, and in this way an estimate could be made by the salesman without delay, the contractor agreeing to take all work accepted by the solicitor. About 200 orders were taken on this proposition in a short time.

Another Southern man hired a monogram talking sign and gave nightly talks on the advantage of electric service and the superior class of work done by him. Still another firm gave a series of lectures on illumination under the auspices of a prominent reflector house and at the end of each talk made appointments for the improvement of specific installations with some of the merchants present.

At a food show, a contractor took a booth and gave a very elaborate lighting display and a demonstration of household appliances in conjunction with the local lighting company. The problem was to find out who among the visitors was interested in having residence wiring installed. A guessing contest was inaugurated and the person guessing the nearest to the exact number of beans in a box was offered one-third off from the wiring cost. The leads developed in this way ran into the hundreds. Another contractor placed motors out on 30 days' trial with the understanding that if a saving was effected the customer was to retain the motor and pay for the installation cost. Out of 23 cases only one motor was returned.

Such schemes create a demand for electricity and the central-station man should do everything in his power to co-operate with and encourage the contractor in this work. Not very long ago there was rather a strong feeling of antagonism on the part of the electrical contractors in Providence, due to the company selling motors, heating apparatus and so forth at actual cost. The first step taken by the company to overcome this feeling and to inaugurate co-operation was to call a meeting of the electrical contractors, at which time questions pertaining to both sides were freely discussed. At this meeting the company agreed in the future to maintain the regular retail selling prices on all motors as established by the manufacturers, thus giving the contractor an opportunity of making a profit of at least 10 per cent. The company further arranged to carry a large and well-assorted stock of motors, and agreed to sell the same to the contractors at the price for which they could be purchased direct from the manufacturer. This was done provided the motors were to be connected to the company's service. It has resulted in the saving of considerable time to the customer, the contractor and the company. Thus each contractor has practically acted as a salesman for the stock of motors. Furthermore, the company never competes with the contractor on the sale of a motor, and, in fact, urges the prospective customer, in most cases, to purchase direct from the contractor. Frequently, a list of motors in stock is mailed to each contractor, thereby keeping him posted.

The central station has taught the contractor the means of providing new business. The contractor has been apt in the appliance of the methods used by the station in pushing the lighting industry. He sees to it that every new building is wired. He is careful to provide outlets for every conceivable application of electricity. In this he is selfish. It means increased earning capacity for his business.

Many of the signs in Lincoln were secured by the aid of the contractor who appealed to the prospective consumer, not as a solicitor for the central station, but as an unprejudiced person anxious to see the town well lighted; anxious that the consumer adopt one of the most effective methods of advertising.

The contractors realize that in order to increase their sales it is necessary to create a demand for electricity, and they are working energetically along this line. For example: A leading contractor while executing a small wiring job for a prominent business house in the town, noticed that the display windows were poorly lighted. He suggested an idea whereby the effect of the goods displayed could be shown up to better advantage by installing additional lamps, which idea the merchant readily adopted, resulting in an additional installation of 50 lamps and a material increase of revenue to the central station. Many such examples of co-operation on the part of the up-to-date electrical contractor could be quoted. They are training not only themselves, but their men to be on the alert, and in every case where they think a suggestion on their part would influence the customer to install additional or new apparatus and appliances they make practical suggestions accordingly.

Many contractors, before bidding on a large deal, request the representative of the central station to accompany them, in order to get his ideas on arranging the lighting system, giving the customer the advantage of their combined judgment and experience. Co-operation with experienced contractors is becoming more and more essential to the central station. It has gained the good will of a closely affiliated fraternity, besides promoting the sale of electricity to a larger extent than before this co-operation existed.

New Telephone Patents.

COMMON BATTERY SWITCHBOARD CIRCUITS.

The operating of telephone exchanges is now so far standardized that practically the same signals and the same talking circuits are required in every instance where a large multiple switchboard is used. The required signals and circuits can be built up in an almost infinite number of ways, as evidenced by the great number of circuit patents which have been issued. This possible variety of design is also evidenced by a budget of circuit patents just issued to Mr. E. R. Corwin, of Chicago, and assigned by him to the Monarch Telephone Manufacturing Company. All of the circuits are designed to permit the usual line and supervisory signals to be given; provide for ringing and talking to the operator, and the interconnecting cord circuits for connecting the subscribers' lines. A few words about each patent will suffice.

The circuit system, which will be considered first, requires a double-wound line relay connected cumulatively with the bat-

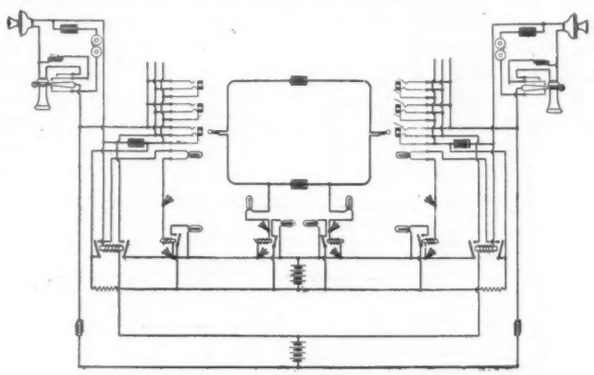


FIG. 1.—CORWIN TELEPHONE SYSTEM.

tery in the middle and the line joined to the outer terminals. There is also required a cut-off relay with a single back-contact. The circuit is of the three-wire type. No supervisory relay is required; the answering and calling cords are split by condensers, and each is shunted by a bridged retardation-coil. The line-relay, responding to the subscriber's switch, causes the line-lamp to glow, by receiving energy through the back contact of the cut-off relay and its own front contact. Upon the response of the operator, the cord circuit, through its bridged retardation coil, connects one of the line limbs to the cut-off relay circuit. This causes the cut-off relay to operate, extinguishing the line lamp. The supervisory lamp or third strand circuit is open at this time. Whenever the line-relay falls back, it completes the circuit of the supervisory lamp through its back contact, which latter is in turn joined to the sleeve of the jack.

In the second system two batteries are required. One of these feeds energy to the line through the line-relay on the one side and a retardation-coil on the other. The second battery operates solely on a local circuit controlling the signals. The line relay makes two independent contacts when operated. In this operated position, if there be no plug in the jack, the line-lamp receives energy through one of its contacts. When a plug is inserted in the jack, the line-lamp is extinguished, even though the line-relay remains operated. The reason lies in the condition that the insertion of the plug causes a short-circuit of both the line and the supervisory lamp. This short-circuit is controlled through the second contact of the line-relay and

through an auxiliary contact in the jack, closed by the sleeve of the plug. A feature of this circuit lies in the fact that pilot signals may be used for both the supervisory and the line lamps by merely including a relay for each pilot in the circuit feeding energy to the respective class of lamps. It will be seen that as long as the supervisory and line-lamps are extinguished there is no current in these feed circuits, because either the line-relay contacts are open or the circuits are short-circuited. The pilot lamps are, therefore, de-energized whenever all of the lamps of a given class are extinguished. The connections may perhaps be understood by reference to Fig. 1, which shows the connections with the pilot relays in the various signal circuits.

In another one of Mr. Corwin's systems there are required a cut-off relay for opening two back-contacts, a line-relay for opening one back contact and closing two forward ones, and two independent batteries. This is a two-wire system. The line-relay is in series permanently with one of the line limbs and is connected to one terminal of the line battery. The second terminal of the line battery is connected to one contact of the cut-off relay and to the cord circuit. When the line relay operates it connects in the line lamp through one of its contacts and cuts in the disconnector relay through the second. The insertion of a plug causes the cut-off relay to operate, to extinguish the line lamp and, at the same time, to clear the line for the application of energy from the battery through the cord circuit. The supervisory lamp, which is associated with the cord circuit, is controlled by the back-contact of the line relay.

In the fourth system there are used a single battery, a line relay with one back and two front contacts and a cut-off relay with one back and one front contact. This is a three-wire system, the control of the signals upon the insertion of the plug residing in the tip strand of the cord being normally connected to the sleeve strand. The line-relay is used in this case also to cut in the cut-off relay, which latter removes the line

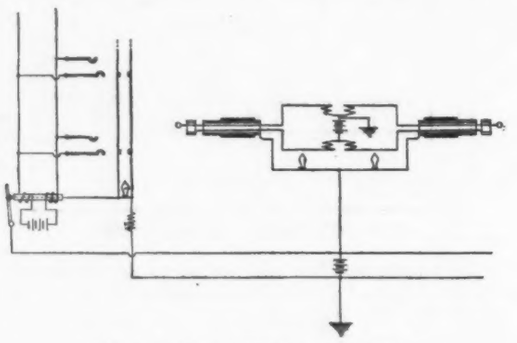


FIG. 2.—RYDER SIGNAL APPARATUS.

lamp at the proper time. The back-contact of the line-relay also controls the supervisory signal.

In the last one of Mr. Corwin's circuits to be described a double-wound line-relay is used, the cut-off feature being included in auxiliary contacts in the jacks, which contacts are separated upon the insertion of the plug. The separation of the contacts opens the line lamp circuit. The back contact of the line-relay controls the supervisory lamp of the cord circuit through the third strand of the cords.

A circuit system is described in a patent recently granted to G. H. Ryder, of Somerville, Mass. In this system there is required a single front-contact line-relay which is double wound, the battery being connected in the middle. A three-strand cord-and-plug is used. The jack-thimble, which controls the signaling, is in two parts, a front and a back, adapted to be connected together by the insertion of the plug. Normally, a line-relay lights the line lamp, but when a plug is inserted the line-lamp is short-circuited by the plug sleeve, which is connected between the two parts of the jack thimbles. The supervisory lamp is, at the same time, in circuit, but it is shunted by the line-relay as long as this latter is energized. Figure 2 shows the circuit.

REPEATING COIL TO ANNUL GROUND DISTURBANCES.

Where long grounded lines are used it has been found that considerable advantage may be attained in the reduction of noise if the connection to the ground at the stations is not metallic, but through condensers. Moreover, the noise may be further reduced if, instead of an ordinary condenser, use is made of a repeating coil having one terminal of its secondary connected to the telephone instrument and the other terminal open; while, on the other hand, one terminal of the primary is connected to the ground and the other terminal open. This arrangement will be recognized as combining inductance and condenser effects.

Mr. I. Kitsee has sought to improve the effect by using in one of the coils a double winding, the two parts being connected up differentially so that their inductive effect upon the associated signal-wound coil is equal and opposite. Mr. Kitsee states that with this arrangement the ground disturbance is very much reduced, as its inductive effeet upon the two oppositely connected coils tends to superimpose and cancel.

Letters to the Editors.

Inspection and Testing of Watt-hour Meters.

To the Editors of Electrical World:

Sirs:—Referring to Mr. A. E. Seelig's letter in your issue of June 27, containing a criticism of a passage in my article entitled "Preliminary Inspection and Testing of Watt-hour Meters," printed in the issue of May 30, I have looked the matter up and find that the statement cited by Mr. Seelig is erroneous. It was taken from an old—and as I now learn, incorrect—data book of one of the meter-manufacturing companies. The second sentence of the two that Mr. Seelig cites should read: "Both potential coils should be excited when the test is made, and the meter tested as a single-phase meter by using one current coil only at time."

I thank Mr. Seelig for bringing this error to my attention and for the advices contained in his letter in regard to his own tests. The article in which the error appeared is one of a number that are now being printed in the electrical press constituting the advance publication of a portion of a forthcoming book on the electric meter, and the comment and corrections of readers are of value for incorporation in the final copy for the book.

New York, N. Y. Joseph B. Baker.

The Series Transformer.

To the Editors of Electrical World:

Sirs:—The following notes supplementing my article on "The Series Transformer" in the Electrical World of May 16, are intended to make clear the points brought up by Mr. M. G. Lloyd in your issue of May 30.

Mr. Lloyd has mistaken the meaning of the curves of Fig. 5. The curves do not show the error due to the power factor of the *secondary* load, but show how the error due to *A'OM* (for values from 15′ to 1° 30′) varies with change in power factor of *line* or *station* load. For instance, if the power factor of the line is 100 per cent the error due to *A'OM* will be proportional to cos *A'OM*. If the power factor of the line is cos Θ, the error will be proportional to $\frac{\cos(\Theta + A'OM)}{\cos\Theta}$ and the per cent error will equal $\left\{1 - \frac{\cos(\Theta + A'OM)}{\cos\Theta}\right\}$ 100. The curves are, therefore, plotted with the vertical co-ordinates equal to the quantity in brackets for various values of Θ at given values of *A'OM*, and the horizontal co-ordinates equal to the power factor corresponding to values of Θ. With reference to the second point brought up by him, Mr. Lloyd is correct. The last part of the last paragraph in the first column on page 1045 in the original article should read: "As the iron loss varies as some power of induction greater than unity the per cent decrease

in the ratio $\frac{watts\ iron\ loss}{volts}$ or $\frac{W}{V}$ (equation 3) is less than the per cent decrease in induction or load." This is readily seen from the following:

Accepting the assumption that the current loss is equal to $\frac{W}{V}$ the loss varies as $\frac{W}{V}$, but W is proportional to B^n and as the flux varies with the voltage, W is proportional to V^n, and if $n = 1.6$, $\frac{W}{V}$ varies as $\frac{V^{1.6}}{V}$ or is proportional to $V^{.6}$.

A little computation will show that as the secondary load or voltage falls off by from 20 to 90 per cent, the value of $\frac{W}{V}$ falls off by from 12½ to 75 per cent for $n = 1.6$.

There is one other slight error which I desire to point out, and that is that in the last equation in the article the quantity $-S$ should appear outside of the radical sign.

FAIRPORT HARBOR, OHIO. E. S. HARRAR.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Electrolytic Rectifiers and Condensers.—G. SCHULZE.—An account of an extended investigation made in the German Reichsanstalt of various electrodes and solutions suitable for electrolytic rectifiers and condensers. The quality of a rectifier is determined by the ratio of the two resistance values of the cell if current passes through it in opposite directions. If this ratio is unity, there is no rectifying effect. The smaller the ratio the better the rectifier. If the ratio is zero the rectifier completely prevents the current from passing in one direction. The chief result of the investigation is that the conditions under which a favorable small resistance ratio is obtained and the conditions of continuity of satisfactory operation appear to be contradictory. Under any circumstances it is very important to avoid impurities in the electrolyte and heating of the cell. Even if the temperature is artificially held down to 0 deg. C., the final breakdown of the cell cannot be avoided (except perhaps with very low current densities). Like other electrolytic apparatus, the electrolytic rectifier is subject to occasional troubles which cannot be foreseen so that it needs constant attendance. But this means that its chief advantage over the rotary converters disappears. Formation of the electrodes by means of direct current is generally not as effective as alternating-current formation. Aluminum electrodes in sodium and potassium salts have a good low resistance ratio, but soon break down. In ammonia salts the danger of a breakdown is less, but the resistance ratio is higher. The resistance ratio and the danger of the breakdown increase with concentration, temperature and voltage. The author did not observe any breakdown with tantalum electrodes, but the resistance ratio is much too high with them. Magnesium has a very low resistance ratio, but is greatly affected by any increase of temperature. While the prospects of the electrolytic rectifier are not good, the valve effect may be used to good advantage for lightning arresters and for electrolytic condensers. For condensers the cells are useful whenever the object is to produce a high capacity with a moderate loss of energy. With alternating current of 160 volts maximum e.m.f., condensers may be made with aluminum electrodes with a capacity of 5000 microfarads in a vessel of 40 x 40 x 40 cm.—*Zeit. f. Elecktrochemic,* June 19.

Parallel Working of Alternators.—M. DUMOULIN.—An account of the results of some experiments on the operation in parallel of self-excited alternators. Most such alternators are excited by rectified currents, and the exciting e.m.f. depends upon the mean value of the potential difference between the brushes, within limits, depending upon the commutation. This mean value varies with the phase, and a displacement of phase produces the effect of a shifting of the brushes, and vice versa. If a self-exciting alternator whose brushes have been shifted, in the sense of the rotation, in advance of the position for maximum e.m.f., is subjected to some kind of perturbation, oscillations will be set up. The alternating potential difference at the brushes will present an increasing retardation of phase with respect to the commutation. This retardation will act practically as a diminution of the forward displacement of the brushes, and will increase the mean rectified e.m.f. The final effect will be diminution of the resisting couple. In the opposite oscillation there will be an increase in the resisting couple, and the oscillations will increase and finally prevent the alternator from working in parallel at all. If, on the other hand, the brushes are shifted in the direction contrary to that of motion, a similar reasoning shows that this condition is particularly favorable to parallel working, since an advance will increase the resisting couple, and a retardation will diminish it. The energy corresponding to the damping in the second case above considered is absorbed by the network, so that no energy is actually lost. The process described has been successfully tested at the Anzun Mines.—*Comptes Rendus,* June 1; abstracted in Lond. *Elec. Eng'ing,* June 18.

High-Tension Direct Current from Alternating Current.—O. M. CORBINO.—If a Ruhmkorff coil is operated with a Wehnelt interrupter and a spark gap is inserted in the secondary circuit, the secondary current is unipolar, corresponding to the opening of the circuit. The current is almost constant and lasts for a considerable portion of the period of interruption. Such a high-tension pulsating current may be rendered practically constant by means of the arrangement shown in Fig 1. R is

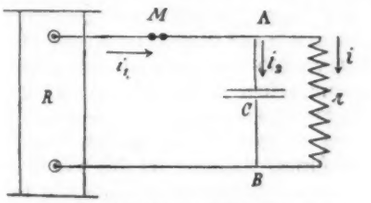


FIG. 1.—DIAGRAM OF ARRANGEMENT.

an induction coil, the primary of which is operated by a Wehnelt interrupter. The secondary contains the spark gap M, the resistance r and in parallel with the latter the condenser C. Whenever a discharge passes through M, the condenser receives a certain charge which partly discharges through r and partly is stored in the condenser. Every succeeding discharge will tend to increase the potential difference between A and B, but in a very short time a stationary condition will be reached. In producing high-tension currents with this arrangement, one is limited by the voltage which the condenser can stand. With paraffin-paper condensers the author produces direct current of 1200 volts.—*Phys. Zeit.,* June 15.

Starting Direct-Current Motors.—P. GIRAULT.—A French Academy paper giving a mathematical comparison of series and shunt direct-current dynamos as to the rapidity of starting. The result of the mathematical analysis is that the series winding gives by far the greater rapidity of starting—*L'Ind. Elec.,* June 10.

Rotary Converters.—E. J. BERG.—A continuation of his long serial on the theory of rotary converters. The present installment deals with automatic phase control and gives numerical examples.—*Gen. Elec. Rev.,* July.

Lamps and Lighting.

High-Efficiency Lamps and Central Stations.—H. REMANE.—The author discusses the probable standard capacity of the high-efficiency lamp of the future. It is certain that the standard size will not be as heretofore, 16 cp, but higher. With gas

incandescent lamps this standard size in Germany is now 60 hefner candles. Electric lamps can be arranged more advantageously than gas lamps and with electric lamps of 50 horizontal candle-power or 40 spherical candle-power it is possible to produce the same illumination as with 60-cp gas incandescent lamps. Moreover, the cost of both is almost the same under ordinary conditions. The author then gives these figures showing the preferment of the public for different sizes of lamps:

cp.	Carbon.	Osmium.	Osram.
16	60	10	—
25	20	55	20
32	15	35	50
50	5	—	30

The figures for the carbon lamp are the average of several years, those for the osmium lamp are the average of more than 4,000,000 lamps sold. The figures for the osram lamp show that 20 per cent of all lamps sold were of 25 cp, 50 per cent of 32 cp and 30 per cent of 50 cp. The maximum demand is therefore for 16-cp lamps with carbon lamps, for 25 cp with osmium lamps and for 32 cp with osram lamps. It is also a fact that cities or countries where a high rate is charged for electricity use chiefly low candle-power lamps, while in towns where the cost of electricity is low, higher candle-power lamps are used. For instance, in Berlin, Leipzig, Strassburg, etc., where the cost of electricity is low, the 50-cp osram lamps are preferred. While in Paris, where the cost of electricity was twice that of Berlin until recently, 16-cp, or at the utmost 25-cp, lamps are employed. From calculations on the cost of different lamps, including the cost of current, renewals, etc., the author concludes that the 32-cp lamp will be the standard lamp of the future for general use. In small stations in rural districts the 25-cp lamp may be preferred, while in cities with very low rate for electrical energy, the 50-cp lamp may be employed. The author does not think that the 220-volt lamp has a promising future compared with the 110-volt lamp. While the 110-volt lamp consumes about 1 watt per hefner candle, the 200-volt lamp will consume 1.25 watt per hefner candle for sizes from 40 to 100 hefner candles. "There is very little prospect that it will be possible to build 32-cp, 220-volt lamps consuming less than 1.4 watt per hefner candle and there is no prospect for several years to come that 25-cp, 220-volt lamps will be made consuming less than 1.6 watt per hefner candle-power." To get electric light as cheap in a 220-volt system as in a 110-volt system with 32-cp lamps, it will be necessary to sell the kw-hour at about 30 per cent less in the former stations; but this will be hardly possible. The author discusses the many difficulties in the manufacture of 220-volt lamps. The following table gives the dimensions of the filament for carbon or osram lamps. The figures given in the column marked "type" represent hefner candle-power and voltage:

CARBON.

Type.	Filament—Diameter.	Filament—Length.	Watt, per hefner candle.
50/220	0.13	400	3.0
32/220	0.12	380	3.5
25/220	0.085	350	3.5
16/220	0.07	275	3.5
10/220	0.06	365	4.0
50/110	0.23	240	3.0
32/110	0.18	230	3.1
25/110	0.16	220	3.1
16/110	0.12	200	3.1
10/110	0.075	175	3.5

OSRAM.

Type.	Filament—Diameter.	Filament—Length.	Watt, per hefner candle.
50/220	0.0342	1,040	1.25
40/220	....	....	1.25
32/220	0.0254	910	1.25
25/220	0.0216	826	1.25
16/220	0.0154	723	1.10
50/110	0.0530	605	1.10
32/110	0.0395	524	1.10
25/110	0.0328	490	1.10
16/110	0.0244	410	1.10

The Welsbach Company makes tungsten filaments on the commercial scale of 0.02 mm thickness for special lamps consuming 1 watt per hefner candle. But if these filaments would have to be used for 16-cp, 220-volt lamps it would be necessary to handle considerable lengths of such filaments and great difficulties would be met with. The higher specific consumption of the higher-voltage lamps is due to electric processes in lamps when being used and these cannot be avoided. The Welsbach Company makes 220-volt lamps because there is a demand for them though the price is rather high. The author is strongly of the opinion that in new direct-current plants it will be far better to select a voltage of 110 than 220 in order to use the best and most economical lamps.—*Elek. Zeit.*, June 11.

Iron Arc.—H. Buisson and C. Fabry.—An account of some experiments in which the authors found that two distinct types of arc are possible between iron electrodes, and that these two types differ by the aspect of the arc and its electric conditions. In the more usual form there is a brilliant point on the drop of molten iron on each of the electrodes, and these points emit the "spark" lines. The flame which joins the two points is brightest over the negative pole, and it is this part of the flame which alone shows the lines due to the rarer elements contained in the iron as impurities. The flame as a whole shows the "arc" lines, and none of the "spark" lines. On increasing the resistance in the circuit, but leaving the length of arc and the e.m.f. unchanged, another form appears abruptly. The point over the positive pole disappears, while that over the negative pole remains constant. For the same current strength, the e.m.f. has to be higher in the second form. Thus, for a current strength of 1 amp, the e.m.f. is 92 volts for the first form and 117 volts for the second. It is one more evidence of the superior importance of the cathode in arc phenomena. An arc can be obtained between a solid terminal and an electrolyte, but only if the latter is the anode.—*Comptes Rendus*, June 1; abstracted in Lond. *Elec. Eng'ing*, June 18.

Illumination.—H. Bohle.—An illustrated paper read before the Cape Town section of the (Brit.) Inst. Elec. Eng. The author gives fundamental considerations and formulas an illumination with a number of lamps with reflectors and applies his methods to special problems of the illumination of buildings and of outdoor illumination. Finally some illumination photometers are described.—Lond. *Elec. Eng'ing*, June 11.

Power.

Power Transmission by Gas.—C. A. Smith.—While the author recognizes all the advantages of electric power distribution, he thinks that for transmission over long distances, transmission of gas may compare favorably with electric transmission. Figures are given for two schemes, in the first of which power gas from producers is used in gas engines to drive three-phase generators, three-phase currents being transmitted to substations. In the second scheme power gas from producers is piped from the central station to substations where it is used in gas engines to drive electric generators. His figures show that this second system has distinct possibilities.—*Cassier's Mag.*, July.

Italian Power Station.—L. Pasching.—An illustrated description of a power plant erected in northern Italy at a coal mine and transmitting three-phase currents at 33,000 volts to five cities in the neighborhood. The power plant contains three generators each of 1800 kilovolt-amperes.—*Elek. u. Masch.*, June 14.

Turbo-Generator.—Details of another 6000-kw turbo-alternator which will be installed at the Manchester electricity works. The turbine will be of the Zoelly pattern, and will be larger than any turbine of that type yet constructed.—Lond. *Elec. Eng'ing*, June 18.

Swiss Transmission Plant.—A fully illustrated description of the transmission system from Engelberg to Lucerne, which is an example of the present tendency in Switzerland to combine single-phase current and three-phase current transmission and distribution in one system.—*L'Ind. Elec.*, May 25.

Traction.

Single-Phase Railway.—An illustrated description of the single-phase railway between Rome and Civitta Castellana in Italy, which is 32 miles long and was equipped by the Westinghouse Company. It consists of two sections, namely, the city section on which a pressure of 600 volts has been adopted and the interurban section on which the pressure is 6600 volts. Special safety devices are used to prevent overhead wires from

falling in case of fracture of the hanger or hanger bolt. There is also a relay in the power station which automatically opens the line circuit breaker in case the trolley-wire circuit is broken. —*Elec. Railway Jour.*, June 27.

Railway Signals.—A description of the automatic signaling system which is being installed on the Metropolitan Railroad in London. It is designed for a headway of one and a half minutes. The working is "all-electric"; that is to say, electricity is used as the motive power for the points and for working the signals, as well as for detecting the positions of the trains. The general principle of working is that the completion of the rail circuit of the train itself sets the signals behind the train at danger.—Lond. *Elec. Eng'ing*, June 11.

Single-Phase Traction in Europe.—The following list gives details of the single-phase railroads installed in Europe:

Name of line.	Length in miles.	Frequency.	Line voltage.	Number of motor-cars with hp on each.	Number of locomotives with hp on each.	Date of opening.
Bergamo-Valle Brembana	19.0	25	6,000	....	5-300	Dec., 1907
Blankenese-Ohlsdorf	41.5	25	6,600	6-250	....	Jan., 1907
		25	6,000	51-345	....	Jan., 1907
Borniage	13.0	40	600	20-80	....	April, 1905
Compagnie Generale Parisienne de Tramways	1.0	..	500	2-50	....	Exper'l
Murnau-Ober-Ammergau	15.0	16	5,000	4-160	....	Jan., 1905
Spindlersfeld	26.0	25	6,000	2-200	....	Aug., 1903
Prussian State Railway	1.5	25	6,600	....	....	Exper'l
Rome-Civita-Castellana	34.0	25	6,000	15-80	....	Mar., 1907
Stubaital	11.75	42	2,500	4-160	....	Aug., 1904
			6,000	....	2-200	
			5,000	....	....	
Swedish State Railways	12.0	25	20,000	....	1-330	Exper'l
			6,000	....	....	
			20,000	....	1-300	
Vienna-Baden	17.0	15	10,000 A. C. 500 D. C.	13-100	....	Jan., 1907
Locarno-Bignasco	17.0	20	5,500	4-160	....	Sept., 1907
Seebach-Wettingen	12.0	15	15,000	....	2-400 1-225	Dec., 1907
Midland Railway	16.6	25	6,600	3-350	....	April, 1908
Brighton Line	17.2	25	6,000	....	....	
Parma Provincial	26.5	25	4,000	17-120 1-60	....	Not yet
Rotterdam-Hague	45.0	25	10,000	20-350	....	open
St. Polton-Mariazell	66.5	25	6,000	....	23-350	for
Tergnier-Anizy	20.0	25	3,300	....	....	traffic.

These are 19 lines totaling 415.5 miles, while in the United States there are 28 single-phase lines totaling 956.3 miles.—Lond. *Elec.*, June 12.

Thermit Welding.—An illustrated description of a particular application of thermit welding on shallow rail, where the process was applied under unusual conditions and required special appliances like wax matrices.—*Elec. Ry. Jour.*, June 27.

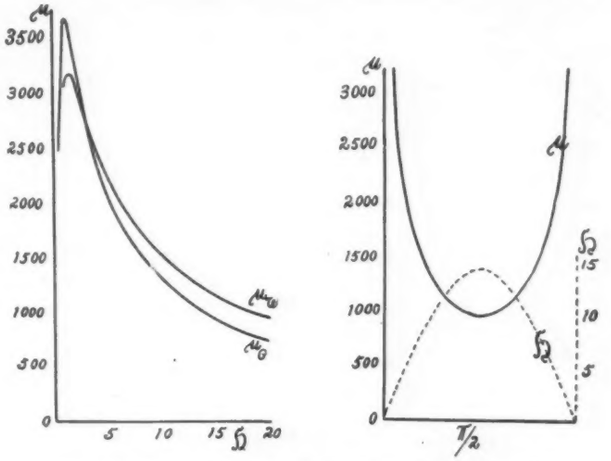
Electric Automobiles.—A. CHURCHWARD.—An article tracing the general lines along which the development of electric automobiles has taken place in recent years. Practically all standard vehicles are now equipped with a single motor and double chain reduction. Great progress has been made in the design of the motor and of the controlling apparatus. A few years ago a commercial vehicle consuming 120 watt-hours per ton-mile on hard level asphalt was considered successful, but lately this limit has been reduced below 100 watt-hours per ton-mile, and in some cases, under favorable conditions, as low as 60 watt-hours per ton-mile has been obtained. Some figures are also given on the size of the battery required and on the effect of the pavement on the behavior of the automobile.—*Gen. Elec. Rev.*, July.

Installations, Systems and Appliances.

British Central Station.—An abstract of last year's report of the Birmingham municipal central station. The number of kw-hours sold was 20,793,670 as compared with 10,887,684 units during the previous year (1906-7), and 5,383,904 units during the year 1905-6. The maximum load on the plant was 11,020 kw, and the capacity of the plant installed 14,740 kw. The load factor was 21.5 per cent. The total works cost per kw-hour sold was 1.098 cents, the total cost including management charges, but not capital charges, was 1.532 cents and the total cost including the capital charges was 2.938 cents (against 4.178 cents in the preceding year).—Lond. *Elec. Eng'ing*, June 18.

Electrophysics and Magnetism.

Alternating-Current Permeabilities.—L. SCHAMES.—In investigations of the effect of frequency on permeability, the value of the latter is the mean value for one period. This value cannot be directly compared with direct-current permeability value. In Fig. 2, μ_g is the curve of the permeability for soft iron



FIGS. 2 AND 3.—ALTERNATING CURRENT PERMEABILITIES.

according to Kohlransch, while the different points of the curve μ_{10} are mean values calculated on the assumption of a sinusoidal alternating magnetic field. For the effective field intensity $H = 10$ (the maximum value being 14.1) the permeability varies during one-half period according to the curve shown in Fig. 3. This gives a mean value 1520, while the direct-current permeability is 1300. The first diagram shows the characteristic differences betwen the two curves. The maximum of μ_{10} is about 15 per cent below the maximum of μ_g. The curves intersect at $H = 2.8$ and later on there is a difference of about 20 per cent between the same. The softer the iron, i. e., the higher the maximum of permeability, the greater are the differences between the two curves and the lower is the field intensity for which the two curves intersect.—*Phys. Zeit.*, May 1.

Radioactivity.—A. S. EVE.—An account of an experimental investigation of the changes in velocity in an electric field of the alpha, beta and secondary rays from radioactive substances. The author determined the coefficients of absorption by aluminum of the incident secondary radiations, due to the beta and gamma rays of radium, produced from various substances. The lighter substances emit negative rays not only less in quantity than the dense, but these rays are initially more readily absorbed. Some substances, such as brick, slate, wood, paper and carbon, give rise to penetrating incident secondary rays originating from several centimeters depth, which are either secondary gamma rays or high-velocity negative rays. After screening, the secondary radiation from brick or paper may exceed that from a heavy substance, such as lead. In an electric field, with the lines of force parallel to those of direction of motion, the velocity of the alpha rays can be increased or diminished, and there is apparently a slight variation of range. The same method may be applied to primary beta rays or to secondary rays due to beta and gamma rays. The amount of secondary radiation is known to follow an order depending on the atomic weights of the radiators. It is shown that the velocities, regarded as a group, as well as the initial absorptions by aluminum, follow the same order, so that the main secondary negative rays are projected with velocities which are a function of the density, or the atomic weight, of the radiating substance, the velocities being greater for the more dense. The main group of electrons, therefore, emerge with less velocity from the lighter substances. The square root of the percentage differences of ionization, due to a reversal of potential of the radiator, is inversely proportional to the secondary radiation from

the radiator. This is a rough approximation for radiators of equal areas made of different substances.—*Phil. Mag.*, June.

Magnetic Rays.—A. Righi.—With reference to the old vacuum-tube experiments of Plücker and Hittorf and recent experiments of Villard, the author discusses the probable existence of a new species of rays, which he calls magnetic rays, accompanying discharges in a magnetic field.—*Rendiconti dei Lincei;* translated in Lond. *Elec.*, June 12.

Units, Measurements and Instruments.

Weston Cell.—H. Tinsley.—An account of some observations made with cadmium cells during exceptionally cold weather. A batch of Weston cells had been made up acording to specifications of the (Brit.) Nat. Phys. Laboratory; they were ordi-

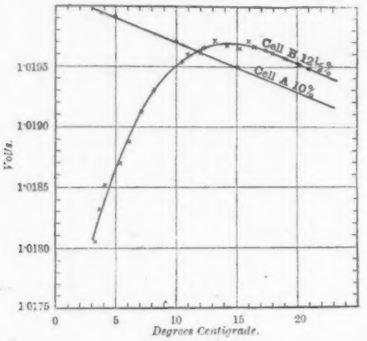


FIG. 4.—VOLTAGE CURVES.

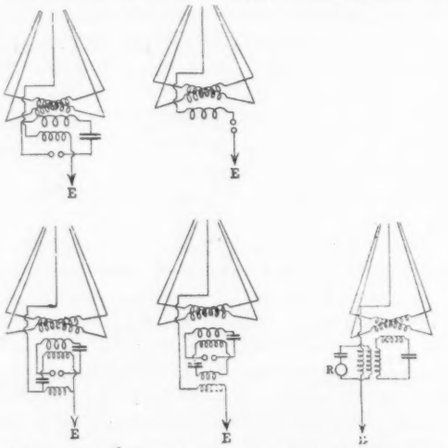
narily in very good agreement with standard Weston cells, but considerable disagreement was found at low temperatures. This is shown in Fig. 4, which gives two curves, *A* for the standard Weston cell and *B* for one typical cell selected from the batch of new cells prepared. The curve *A* was plotted from the known value of the voltage and temperature coefficient of the master cell, whereas *B* represents the varying voltage of the selected cell. The lowest temperature was 3.2 deg. C., at which the difference between the two cells amounted to 190 parts in 100,000, which difference gradually decreased till it became zero at 12 deg. From this point the new cell's voltage is in excess of the master cell till about 16 deg., when its curve bends downward, thus showing a true negative coefficient of the same value as the master cell. Below 15 or 16 the cell *B* has a positive coefficient, whereas above this temperature its value varies identically with *A*. Cell *A* was made with a 10 per cent cadmium amalgam, whereas cell *B* was made with 12½ per cent amalgam. The amalgam in cell *A* was observed to keep bright throughout the range of temperature and have a surface appearance very similar to pure mercury, whereas at the lower temperatures cell *B's* amalgam appeared to become solid and lose its bright appearance, becoming like the surface of new galvanized iron. The author thinks that the different behavior of the cells may be due to the different percentage of the amalgam used.—Lond. *Elec.*, June 12.

Small Variable-Frequency Alternating Currents.—B. S. Cohen.—A Brit. Phys. Soc'y paper on the production of small variable-frequency alternating currents suitable for telephonic and other measurements. His method consists of a form of vibrating wire interrupter which operates a make-and-break contact. This is used to put a source of potential on and off a resonating circuit tuned to any desired frequency. The alternating current is taken from a small transformer in the resonating circuit. A series of damped wave-trains of any frequency can be produced by this means, the trains following each other with the frequency of the wire vibrations. Several forms of circuit are described, one of which gives a train of oscillations at each break of the supply circuit. Other circuits give damped waves, both on the break and on the make contact, and by a suitable combination of two oscillating circuits worked from one mercury cup and contact it is shown that continuous and fairly uniform oscillations can be produced.—Lond. *Elec.* June 12.

Measuring Small Quantities of Electricity.—In order to increase the sensitiveness of electrometers and thus to permit of their employment for measuring small quantities of electricity, Einstein proposes the use of an electrostatic machine made up of any number *n* of influence machines, analogous in principle to the Thomson replenisher, connected in cascade. Under these conditions, if P_1 is the potential of the armature of the first machine, that of the collector of the *n*th which is connected to the electrometer will be $P_n = a^n P$, *a* being a constant greater than unity, for instance, in one case it was 10. Owing to this arrangement, charges of low potential P_1 can be detected on the electrometer when they themselves would be insufficient to deflect it.—*Phys. Zeit.*, April 1; Lond, *Elec.*, June 12.

Telegraphy, Telephony and Signals.

Directive Wireless Telegraphy.—E. Bellini and A. Tosi.—An abstract of a Brit. Phys. Soc'y paper describing their system of directive wireless telegraphy. They employ two closed radiators, fixed in vertical planes at right angles to one another, and, by means of an apparatus called a radiogonometer, they adjust the phases of the waves emitted by the two closed radiators so that the energy is transmitted principally in one plane. The closed radiators are usually of the convenient form of wire triangles supported from the same mast. An important improvement on the apparatus consists of means for transmitting principally in one direction and not merely in one plane—that is, the radiated energy is despatched practically wholly toward one side of the sending station, as well as principally in one plane. This improvement is effected by adding a plain vertical aerial wire to the sending aerial system, and by exciting this added aerial just so strongly, and with the right phase relation, as to annul the radiation sent to the one hand by the closed-circuit aerials and to add to the radiation sent to the other hand by the closed-circuit aerials. For this purpose the authors excite the aerial inductively from the moving coil of the radiogonometer. This secures the simultaneous excitation of the closed oscillatory circuits and of the vertical antenna and ensures perfectly uniform excitation of the latter, however the moving coil of the radiogonometer be rotated. Various arrangements, which have been employed are diagrammatically shown in Fig. 5. In the first of these arrangements the excita-



FIGS. 5 AND 6.—DIRECTIVE WIRELESS TELEGRAPHY.

tions of the two systems are in phase; in the other three cases they are in quadrature. The process at the receiving end is exactly the reverse of that at the transmitting end. The incoming waves excite oscillations in the closed-circuit aerials and in the vertical aerial simultaneously. By a modified receiving radiogonometer these oscillations act on the detector. If the waves come from one side, the effects are added; if from the other, the effects of the two systems are subtracted. It is found necessary to obtain quadrature between the action of the vertical system and that of the closed-circuit system on the detector. This is effected very well by means of the arrangement shown in the diagram of Fig. 6, where *R*, the detector, is in tuned circuit linked through one inductive coupling with the vertical antenna, and through two inductive couplings with the closed-circuit aerial system.—Lond. *Elec. Eng'ing*, June 18.

Induction from Three-Phase Lines on Telephone Circuits.—E. MILLER.—His Inst. paper on inductive interference with telephone circuits in proximity to high-potential transmission lines, with special reference to the results obtained on the Pacific Coast.—*Am. Tel. Jour.*, June 20. A critical discussion of the subject is given in an editorial article in *Am. Tel. Jour*, June 27.

Miscellaneous.

Electrical Porcelain.—H. W. BRADY.—An account of the methods of manufacture used in England for making porcelain for electrical purposes (insulators, etc.). In the conclusion the author thinks that in general English electrical porcelain is superior to the product of other countries. With regard to substitutes for porcelain in outdoor line insulation, these are almost extinct in England. Glass insulators are still used extensively in America for telegraph and telephone line work. Their first cost is less, but on account of breakage due to expansion and contraction the saving is at best doubtful. The coefficient of expansion of porcelain being lower, this trouble is avoided by using that material. The loss on glass insulators in Mexico, for instance, is so high that the government of that country is considering the question of paying the slightly higher prices and adopting porcelain. Reconstructed granite was once a competitor in third-rail work, but has quite disappeared in England. "It survives to a surprising extent in America, surprising because either in the matter of freedom from surface leakage or puncture under high electrical pressure, its merit is but little or nothing." In the only case in which reconstructed granite was used in England on a really extensive scale, the insulators fired so very frequently that they were soon done away with. What happened was simple. Dust, oil and dirt of all kinds would lodge on the rough surface of the granite, and when the rain came, sufficient leakage took place to develop an astonishing degree of heat. At night the insulators could be seen to glow. At any rate, they were all very soon removed and porcelain insulators substituted. "Most of the so-called porcelain insulators used in or emanating from America are very poor. We cannot disparage the Continental insulators except on the score of brittleness, but the American production is generally porous and quite dependent on the glaze for insulation. Exception must be made, however, to American high-tension insulators, which are of vitreous substance, though here, again, there is room for criticism, this time on the ground of appearance. They generally look rough and dirty." Another question coming to the front is ivory versus porcelain for articles as switch bases and other insulators that are protected from mechanical damage and from the weather and intended for low voltages only. For two reasons the British maker advocates the use of porcelain for such articles. First, because it is the best material for the purpose and costs the manufacturer no more to make than ivory. "But it is a selfish world, and our manufacturers' second reason is that the ivory switch-base meets with competition from Germany."—Lond. *Elec.*, May 29 and June 5, 12.

BOOK REVIEWS.

ELECTRICAL CONTRACTING. By Louis J. Auerbacher. New York: McGraw Publishing Company. 160 pages, 225 illustrations. Price, $2.

The 12 chapters which go to make up this book are replete with information of value to that class of readers to whom the work is dedicated. The financial as well as the practical details of the business are treated in a way understandable to electrical contractors, and those points which the individual actively engaged in installation work can best appreciate are brought into prominence, while matter having only a distant bearing on the subject is omitted. The chapters on shop systems, estimating and specifications for house wiring are particularly appropriate. The various systems of wiring are considered from the viewpoint of the contractor and the details of construction are in accord with the requirements of the National Board of Fire Underwriters. The latest electrical household devices are illustrated and described; every branch of work which falls within the province of the average electrical contractor is covered, and taken all in all the book is well adapted to his needs.

ELEKTRISCHE BAHNEN IN NORDAMERIKA. By Dr. Wyssling, with notes by Engineer K. Wirth, Zurich, Switzerland: Rascher & Company. 302 pages, 123 illustrations. Distributed by the Swiss Commission for the Study of Electric Railway Operation.

During September and October, 1906, Dr. Wyssling, general secretary, and K. Wirth, engineer of the Swiss Commission for the Study of Electric Railway Operation, visited the United States and Canada to investigate the different classes of electric railway construction and operation. The results of this trip are embodied in an excellent report by Dr. Wyssling, which contains descriptions of all the roads visited, and comments on their equipment and operation. Particular note was taken of interurban electric railways, as such lines correspond more closely to the Swiss trunk line conditions than the great American steam railroads. Both overhead and third rail lines met with the approval of the visitors and what they saw of single-phase service convinced them of the practicability of this form of alternating-current traction. In addition to articles on the different railway systems, there is a general description of the principal railway apparatus of the General Electric and Westinghouse companies.

NEW APPARATUS AND APPLIANCES

New High-Efficiency Incandescent Lamps.

The General Electric Company has recently brought out a number of new high-efficiency incandescent lamps, including a 250-watt tungsten, a 25-watt tantalum and a number of miniature and battery types of tungsten lamps. The 250-watt tungsten lamp gives a mean horizontal candle-power of 200 or over 300 distributed candle-power when used as an incandescent unit with a prismatic reflector. The lamp is made in a pear-shaped bulb 5 in. in diameter and is the most powerful incandescent lamp made for practical lighting service. The lamp is desirable for use where outlets are limited and where a large unit is required to replace a gas arc or electric arc lamp. Recent tests in a department store in Newark, N. J., are said to have shown an average lamp life of 900 hours.

The 25-watt tantalum lamp gives 12½ mean horizontal candle-power. The lamp is made in the regular 16-cp carbon-lamp bulb and presents a more graceful appearance than the 40- and 50-watt tantalum lamps in the special shoulder bulb. The lamps should prove very popular for domestic service and can be used in conjunction with the tungsten lamp for ordinary socket installations where it might not be desirable to install the tungsten lamp on account of its size and higher cost. The lamp burns in any position and is serviceable on alternating-current circuits of 60-cycles or circuits of lower frequency. The company has also developed a complete line of tantalum train-lighting lamps made in 30-50-volt and 60-65-volt sizes, in both round and pear-shaped bulbs.

An extensive line of tungsten low-voltage lamps in miniature and standard bulb types has been brought out by the company. Tungsten, by reason of the high efficiency it secures, is peculiarly adapted to the battery type of lamp where low energy consumption is a prime requisite. In the low-voltage lamps, tungsten can be used to advantage as the filaments are short and this insures good, stable filaments sufficiently strong to withstand the shocks of automobile service. The miniature lamps

are supplied for electrical novelties, portable devices, pocket lamps, etc., and are particularly applicable for automobile service as a substitute for oil and acetylene lamps. The lamps can be operated from regular ignition batteries, and are much more simple and convenient in every way than the oil and gas lamps. The lamps are made for voltages ranging from 1½ to 20 and for candle-powers ranging from fractional candle-powers up to 24 cp. The specific consumption of the lamps is said to be 1¼ watts per candle with excellent life and superior quality of light.

Steam Boiler Water Purifier and Circulator.

Figs. 1 and 2 herewith show the essential parts of a boiler water purifier and circulator made by the Economy Specialty Company, of 244 Fulton Street, New York City. Water enters the pan at one end and in its movement to the other end it is heated to the temperature of the boiler; the salts and other scale-forming substances carried in solution or in suspension being precipitated. The suction created by the operation of the trap shown on top of the boiler is said to remove the precipitation, before it has a chance to solidify into the filter, where the solid matter is removed from the water, which then passes to the trap and, when a sufficient amount has accumulated, into the boiler again. The velocity of the discharge depends upon the elevation of the trap above the water line, and in practice the return steam trap is set from 6 ft. to 8 ft. above the water level; this is claimed to be sufficient to produce an active operation of the trap and the free discharge of the purified water into the boiler. As the trap operates by the condensation of steam, it is able to continue its operation so long as steam is delivered to it and the circulation and purification of the feed water can thus be maintained as long as the boiler is under steam. In large power plants a centrifugal pump may be used to circulate the water through the filter and boilers; but such a pump obviously requires a motor to drive it, whereas the return steam trap requires no motor and operates at a much lower pressure. The return steam trap also has a very great advantage in its intermittent action, which results in somewhat of a reflux in the filter with a subsequent back-flushing of the filter bed. A check valve connected to one end of the pan permits the circulation of water directly from the boiler through the filter whenever the supply of feed water is cut off, as necessarily occurs whenever the proper water level is reached. This check valve enables the filter and trap to purify the boiler water continuously when not operating directly upon the feed water. A pipe is shown ex-

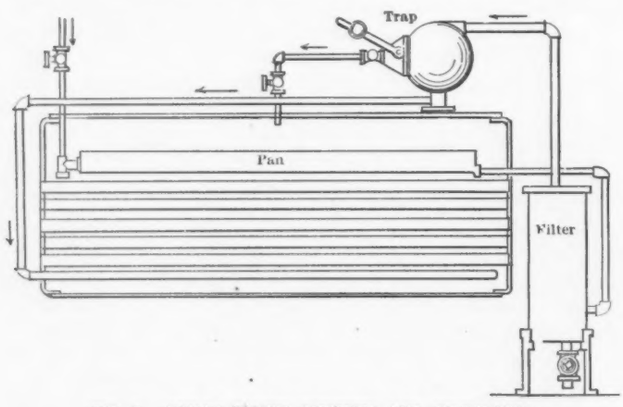


FIG. 1.—BOILER WATER PURIFIER AND CIRCULATOR.

tending downward from the check valve to draw the water from a lower point in the boiler, and such pipe, depending on the construction of the boiler, may be extended to any portion of the boiler to circulate the water therefrom through the pan and filter when feed water is not being supplied. The curved flanges on the pan throw backward any water which rises along the sides. The pipe is shown connected to the bottom of the pan so that the sediment can be drawn off without forcing all the feed water through the filter. In practice the trap and filter will be required to handle only a small portion of the feed water as the sediment is carried along the bottom of the pan into the pipe by the movement of the water and such portion of the water is withdrawn and purified. The maker claims that the partial vacuum which is produced by the trap upon the outlet of the filter enables the boiler pressure to discharge the

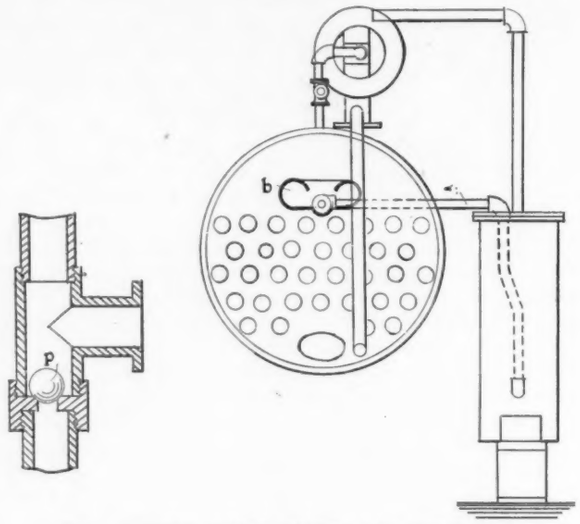


FIG. 2.—BOILER WATER PURIFIER AND CIRCULATOR.

water through the pipe and through the filter so that the operation is not dependent merely upon a vacuum, but by the opportunity afforded for such boiler pressure to operate when the chamber within the trap is intermittently open to the atmosphere.

New Ceiling Reflectors.

Among several new types of corrugated, one-piece, mirrored reflectors which the National X-Ray Reflector Company, of Chicago, has been bringing out recently are two intended for use on lamps placed at the ceiling of large public rooms. One of these is a ceiling rosette of ornamental design, as shown in Fig. 1. The rosette is small, being made for a 1⅝-in. holder and having a diameter of 5 in. It is ornamental in appearance, and especially adapted to use on studded ceiling lamps in restaurants and other public places where a decorative effect is desired. The reflector, although small, has a considerable influence on the distribution of light and increases the downward illumi-

FIGS. 1 AND 2.—CEILING ROSETTE AND CEILING REFLECTOR.

nation materially, as is shown by the accompanying photometric curve, Fig. 3.

Another novel type of reflector for ceiling use is shown in Fig. 2. This is intended for use on very high ceilings where the reflector would not be conspicuous. As X-ray reflectors have an opaque silvered reflecting surface, provision is made in this reflector for letting enough light go upward and horizontally to illuminate the ceiling by leaving the neck of the reflector free from silvering and frosting it. The lower part of the

reflector directs the light downward from a silvered reflecting surface which has upon it a peculiar design which gives a rich

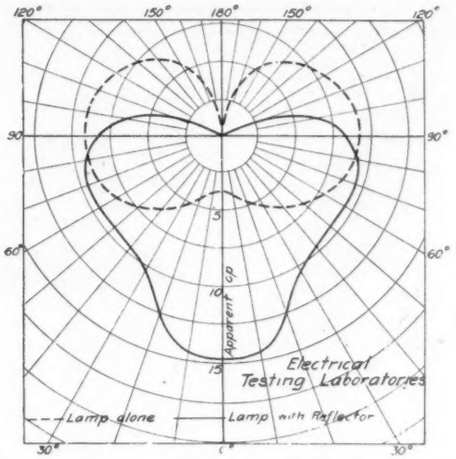


FIG. 3.—LIGHT ABOUT CEILING ROSETTE WITH 8-CP LAMP.

appearance when viewed from below. The photometric curve (Fig. 4), which gives the distribution of light about this re-

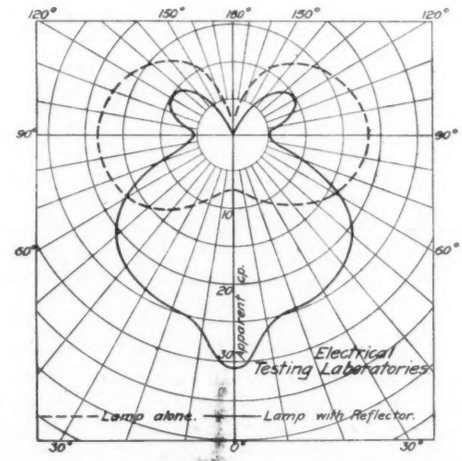


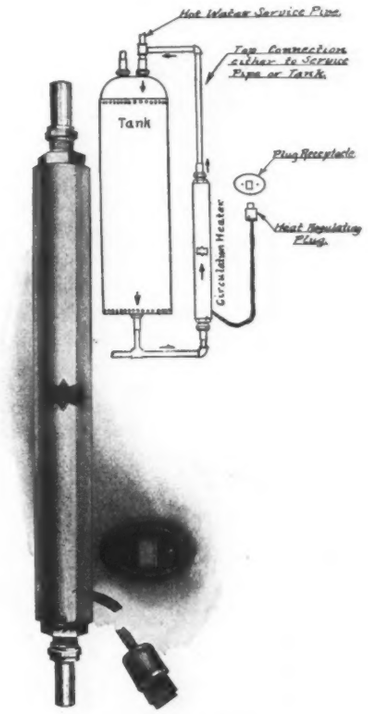
FIG. 4.—LIGHT ABOUT FROSTED NECK CEILING REFLECTOR.

flector, illustrates these points. About 68 per cent of the light is thrown below the horizontal and 32 per cent above to light the ceilings.

Electric Water Heater.

The Simplex Electric Heating Company, Cambridge, Mass., has recently put on the market a circulation heater for attachment to a range boiler, which has been designed to overcome many of the objections and difficulties of taking care of the hot-water problem electrically. As shown in the illustration, the heater is placed along the side of the boiler, connected at the bottom through the pipe that also connects to the range, and at the top with the pipe that supplies hot water to the house. This heater is so constructed that when the current is turned on it will in a few minutes begin to discharge water at about 180 deg. in the top of the boiler, drawing its supply from the bottom of the boiler so that in a short time after the heater is turned on there is but a small portion of the water in a large boiler heated. The maximum current demand for this heater is 2 kw, and when applied as described, makes the boiler more efficient in the case of quick delivery of warm water than when the range is in operation. The current demand on the station is within reasonable limits, and for all practical purposes meets the average household demands.

The heater is arranged with three heat divisions, so that 500, 1000 and 2000 watts may be used, as desired. Where considerable hot water is required, the maximum heat may be turned on for a limited time and then the temperature of the boiler kept up with the low heat. Where a large quantity is not desired, such as that merely needed about the kitchen for ordinary requirements, a short period of the use of the maximum heat enables the supply to be provided at low cost. The efficiency of the heater is very high. The heater consists of an enameled tube through which the water passes. Surrounding the tube is an outer brass shell or jacket lined with asbestos, which provides a closed air space between the tube and the jacket. The feature of construction of the heater which contributes to its efficiency in a large measure is the fact that the enamel, the heater and the tube are practically homogeneous, so that the heat is conducted directly to the water through the shortest pos-



ELECTRIC WATER HEATER.

sible path from the wires embedded in the enamel. Its durability is guaranteed by this feature, which insures the quickest possible conduction of the heat generated to the water.

A peculiar feature of its construction is the control of the circulation which insures the delivery of high-temperature water, thereby permitting hot water to be drawn in a short period after turning on the current while utilizing all present house plumbing in the normal way and yet without having to heat up the entire contents of the boiler.

The use of this device with reasonable control is entirely practical and commercial in all communities where power rates are made for electric cooking, and in many other cases where the convenience and simplicity of the method are allowed to offset the difference in cost over the usual methods. In practice, in the ordinary home, even at lighting rates and where care is used, the total cost for the use of this heater during such occasional intervals as it may be required in the summer time need never be large, or reach a point which would make its use prohibitive.

The installation of the heater involves but a small job for the plumber and electrician, so that the total cost of the equipment is quite moderate. The device is 3 in. in diameter, 33 in. long, with ¾-in. couplings on either end, and when connected stands close to the boiler, taking up little room. All of the outer portions are nickel-plated brass. For connecting to circuit it is provided with a plug switch and flexible conductor.

The Functions of the Consulting Engineer.

A circular recently issued by the Cutter Company, Philadelphia, sets forth in clear and concise language certain considerations on manufacturing standardization. A portion of the circular is reprinted below:

"May not standardization carried to extremes be as destructive as dry rot? Is not, indeed, standardization the most insidious form of dry-rot to which old and firmly established concerns are especially liable?

"Can the world's commerce be secured and maintained by such close adherence to the existing standards as to preclude natural and logical development and progress?

"Has not a man a right to buy what he wants? Are manufacturing standards faultless? Shall we force a man to buy what we want to sell rather than what he ought to use?

"These questions resolve themselves into one: 'What are the functions of the consulting engineer?'

"Are they not to select what is best for the client to use rather than what is easiest for the manufacturer to supply?

"Who is the best judge as to what is required, the man who has made a study of the conditions, or the salesman who seeks to sell a set-standard piece of apparatus because more money can be made that way with less trouble?"

Small Gasoline Blow Torch.

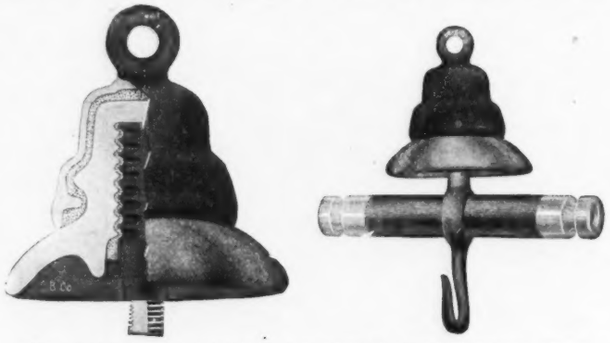
The accompanying illustration shows a small blow torch brought out by the Frank Mossberg Company, of Attleboro, Mass. The device is quite compact and simple. It is automatic in operation, has no pump or valve, needs no tools, starts

GASOLINE TORCH.

with a lighted match and gives, it is claimed, a clean, powerful flame for over two hours on 4 oz. of gasoline. The corrugated neck is said to increase the heating surface to such an extent that the flame of a match easily generates gas enough for starting, after which the mixing tube renders further attention unnecessary. The torch is given the trade name of "Imp."

Insulated Arc-Lamp Hanger.

The arc-lamp hanger shown in the accompanying illustration is claimed to furnish a perfectly insulated and mechanically strong support for electric-arc lamps operating on circuits of 10,000 volts and lower. The hanger is made in three forms—with hook suspension, threaded stud suspension and with hook and spreader arm. Each form embodies a malleable-iron shell, provided on the interior surface with two segments of a circular flange. The upper half of a porcelain insulator fits into the shell, the shoulder of the insulator being cut away on two sides to admit it past the flanges, a quarter turn then locking the insulator in the shell. The interior of the insulator is threaded to admit a threaded pin, which carries the hook or stud. Spaces between the insulator and shell and between the threads of insulator and pin are filled with a special cement. Two sides of the pin are cut away to the bottom of the threads, the spaces thus formed being filled with cement which prevents the pin from backing out of the insulator. Each hanger is tested at 30,000 volts. The locking feature prevents the insulator from dropping out of the shell even though the cement becomes loose, and also prevents shearing stress on the cement, the latter be-



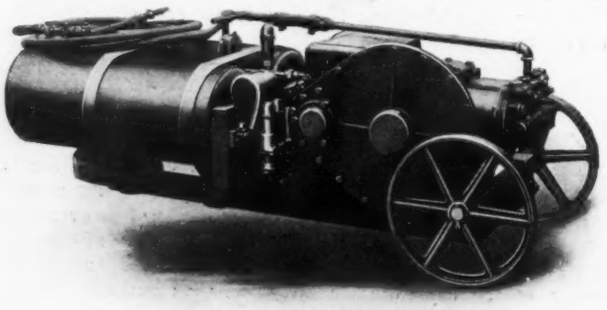
FIGS. 1 AND 2.—INSULATOR IN SECTION AND EQUIPPED WITH SPREADER ARM.

ing under compression only. The device presents a solid one-piece construction, with no parts which can work loose. The wide skirt of the insulator prevents surface leakage. The Ohio Brass Company, Mansfield, Ohio, makes this hanger.

Horizontal Blowing Outfit.

In response to the demand for a horizontal blowing outfit embracing the same general principles as the standard vertical plant, which has been in successful operation for several years, the Westinghouse Air Brake Company has designed the outfit shown in the illustration. It differs from the vertical plant chiefly in arrangement and more compact construction, and is intended for use where conditions do not permit convenient movement of the vertical apparatus. Portable plants are now in wide demand for cleaning electrical and other machinery, and for many services for which compressed air is the most convenient and economical agent.

The new horizontal plant consists of a motor-driven air compressor with one or two brazed reservoirs, an electric pump governor and the usual accessories, such as switch, fuse blocks, gage, safety valve, insulating hose connection and hose with nozzle. The truck frame is made of a single piece of standard shape angle iron bent into the shape of a U, and is cross-braced at the back under the compressor. The rear axle is a piece of



HORIZONTAL BLOWING OUTFIT.

square steel bolted directly to the frame. The compressor bedplate bolts to the frame at each corner. The reservoirs rest upon angle-iron supports and are held firmly in place by means of wrought-iron straps bolted to the frame. A very simple switchboard is placed between reservoirs and compressor, upon which the governor, fuse blocks and switch are mounted. The position of the governor renders it easily accessible for adjustment and maintenance. There is ample room to open the commutator door and examine the brushes. The compressor cylinder head can be removed and the pistons taken out without disturbing the balance of the apparatus.

If it is ever necessary, the gear-case cover can be removed by first removing one of the rear wheels, which is easily accomplished. All oil fittings are easily accessible. The rear wheels are 18 in. in diameter, and the front wheel 8 in. in diameter, and the latter can be turned through an angle somewhat greater than 180 deg. The handle is bent so that when it lies back between the reservoirs, the end of it will not protrude above the other apparatus on the truck. When the reservoirs are used, they are drilled symmetrically so that if removed, either one can be put back on either side. The width of the outfit is such that it can be run through aisles 31 in. wide, and its height is such that it can be stored under a bench if desired. The disposal of the apparatus on the truck brings about two-thirds of the weight on the rear axle. The type shown in the illustration can, of course, be varied in arrangement to suit conditions, and the truck may be furnished with roller bearings.

Meter Testing Portable Load Box.

By H. W. YOUNG.

In testing watt-hour meters it is necessary that some load be provided and many methods of accomplishing this have been devised. The working or house load itself is frequently used, but this is not always desirable, in that it becomes necessary

FIG. 1.—LOAD BOX COMPLETE.

for the meter tester to make several journeys through the house to turn the lamps off or on in order that the desired testing load values may be secured.

The undesirability of the natural load method of testing led to the development of the artificial load method, which usually

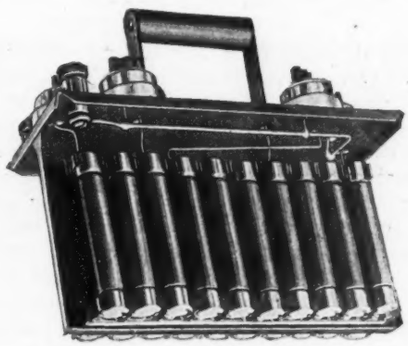


FIG. 2.—SHOWING METHOD OF MOUNTING RESISTANCES.

consists of providing a portable adjustable lamp bank so mounted that lamps can readily be switched in or out of service. The portable lamp bank load has been widely employed, but has the disadvantage of being heavy, bulky and frequently difficult to transport. To overcome the objectionable features of the lamp bank the portable load box has been developed, this device usually consisting of several resistance units so arranged and grouped that by means of series parallel connections, different current values be secured.

One of the latest developments in artificial loads for meter testing is the resistance box, shown in the accompanying illustration, and supplied by the Central Electric Company, Chicago, Ill. This box differs radically from previous types, in that the resistance units consist of removable cartridge tubes, fitting into standard code fuse clips mounted on a center support. The design permits of instant removal or replacement of any unit and also allows a wide variation of capacities. The

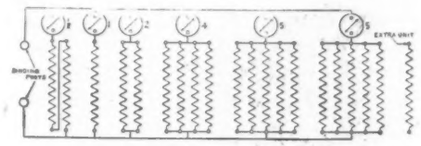


FIG. 3.—DIAGRAM OF INTERNAL CONNECTIONS.

internal connections are so arranged that by means of six (enclosed indicating) switches, located on the top of the box, the resistance units can be instantly connected in various combinations and the meter load quickly adjusted to the desired value. Each switch is plainly marked with the value of the current that it cuts in at full line voltage.

The construction adopted is extremely convenient as all the various parts are securely attached to the cover and compactly interconnected with heavy copper straps by means of two catches. The protecting box can easily be removed and the entire mechanism exposed for inspection. The standard capacities have a range of from ½ amp to 17½ amp in ½-amp steps at 110 volts normal. The resistances are non-combustible, and can be furnished for use on 110 or 220-volt circuits alternating or direct current. Wide variations in voltage will not seriously impair the resistance units which are sealed in air-tight removable tubes—in fact, these interchangeable units are as easily handled as the well-known standard code fuses. Each box is provided with suitable binding posts for connection to the circuit and with a convenient handle. The weight is about 12 lb., dimensions 12 in. by 5 in. by 9 in.

FIG. 4.—RESISTANCE UNIT REMOVED FROM HOLDER.

The use of this resistance box or artificial meter load not only avoids the use of the house load, but enables the meter man to test a very much larger number of meters per day, and while primarily designed for use with the well-known rotating standard test meters, such as furnished by the various meter manufacturers, it is equally well adapted for use with the indicating wattmeter and stop-watch method of testing.

New Non-Metallic Flexible Conduits.

A new non-metallic flexible conduit is shortly to make its appearance. This flexible conduit is called "Verus" and is made of narrow tubular sections of asbestos fiber treated with moisture-proof insulating compounds which do not seriously impair the fire-resisting properties of the asbestos fiber. The conduit is claimed to withstand a temperature of about 400 deg. C. On the outside of these sections is placed a tubing, the whole being then provided with a woven cover treated with regular insulating compounds to which are added certain ingredients which give the finished conduit an elastic exterior that does not crack under repeated bendings. The conduit, the manufacturer claims, is both fire-proof and moisture-proof. In addition to the asbestos-lined conduit, flexible conduits with rubber tube lining, spiral insulated-fiber lining, and also with a spiral, fiber-lined, insulated interior inside of which is a woven highly insulated interior in the form of a tube, are manufactured and are now on the market. The conduits are manufactured by the Protecus Electric Manufacturing Company, of

Allegheny City, Pa., for whom A. P. Pierson, of 23 North Juniper Street, Philadelphia, is the general sales agent. The conduits are made in regulation sizes and in standard lengths.

Assembling Tools for Renold Chain.

An improvement has been added to the Renold silent and roller chain, as shown in Fig. 1. This consists in the use of two semi-circular bushings in each joint, and of a length equal to

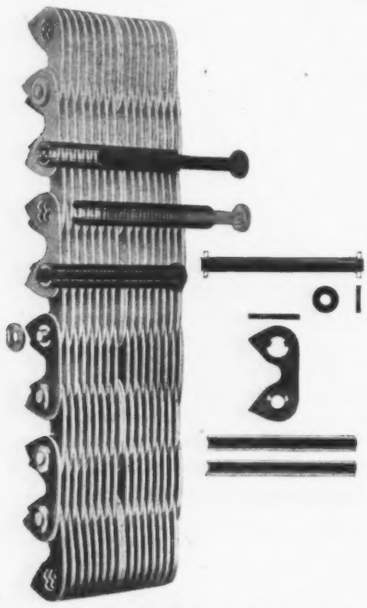


FIG. 1.—IMPROVEMENT IN CHAIN JOINT.

the width of the chain. This new arrangement besides allowing for the proper articulating movement, permits complete rotation of the pin, which is of decided value, inasmuch as possible wear is thus rendered free from unevenness, while the accuracy of fit minimizes any tendency to elongation with its accompanying wobble. Another point made in favor of the new construction

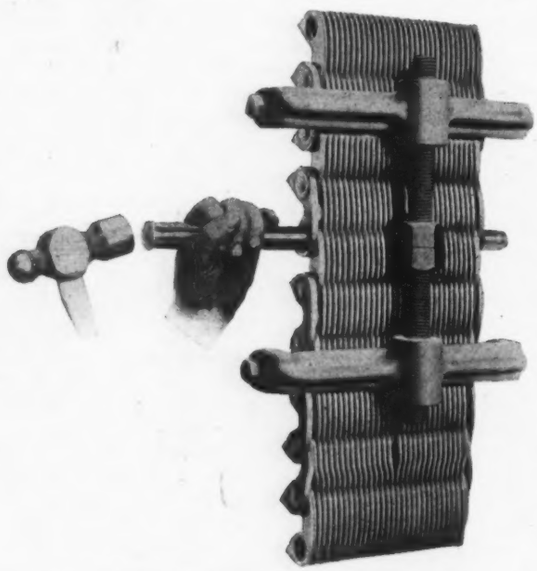


FIG. 2.—METHOD OF CONNECTING ENDS OF CHAIN.

is the complete absence of contact between links and pin, which relieves the latter of concentrated pressure and eliminates the internal wear so destructive to proper service.

In the process of installing the chain drives, the makers devised special appliances to facilitate the work of connecting the links. Fig. 2 shows what is termed a *cramp*—a specially-designed holder made of cast-iron members for gripping the ends of the chain, and connected by a screw for drawing the gripped ends together when fastening them. This is accomplished by fitting the bushings to a short drift pin of proper diameter to lead into the holes of the links, after which the pin is inserted and with a few light blows is driven into position.

The device shown by Fig. 3, termed a "fork and anvil," is used exclusively with the roller type of chains. With it these may be handled very easily, as it is only necessary to slip the forked parts between the rollers, with the lower part of the links hanging into the channel of the anvil block. Release of the links may be made quickly by slipping the fork off the anvil. The advantage of these tools in being of a size that is easily portable will commend them to users who have occasion to lengthen or shorten drives, or otherwise make changes in the

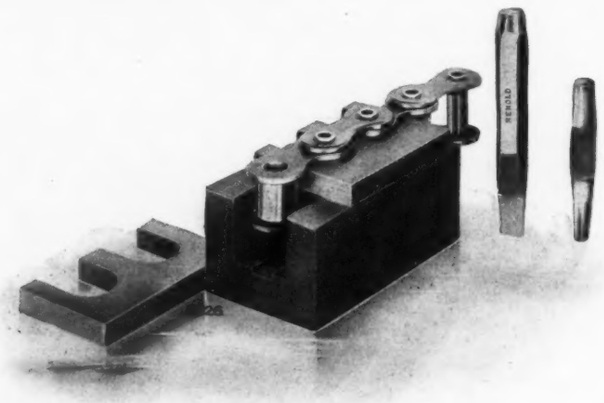


FIG. 3.—"FORK AND ANVIL."

chains. A punch and chisel are included in a kit. The Renold chain is made in this country exclusively by the Link-Belt Company, Philadelphia.

Zoelly Turbines for Manchester, England.

An important contract for turbines has been secured by Messrs. James Howden & Company, Limited, of Glasgow, the apparatus to be for the electrical generating station of the Manchester Corporation. There were seven tenders considered by the corporation, four of which were for turbines of the Parsons type and three of the Zoelly type. One of the tenderers for the latter type was Messrs. Escher, Wyss & Company, of which Mr. Zoelly, the patentee of the system, is the managing director.

The Zoelly turbine has made great progress in recent years in France, Germany, Austria and other Continental countries, and though more expensive to construct than the Parsons type, it is claimed to be more economical, especially in working below full power, than any other turbine, a matter of much importance in these machines where the output of electricity varies so greatly during the hours of the day in which they work.

Messrs. James Howden & Company, Limited, have made the largest turbines of this type at work in Great Britain, one of 2000 kw being at the Powell-Duffryn Collieries at Aberaman in South Wales. This turbine has proved so satisfactory in its working that the Powell-Duffryn Company some time ago gave Messrs. Howden a repeat order for a Howden-Zoelly turbine, which they have now under construction. A deputation from Manchester Corporation, including the city electrical engineer, Mr. S. L. Pearce, lately inspected the Powell-Duffryn machine, and were so satisfied with its working and its economical results that this was doubtless one of the principal factors in influencing the decision of the Manchester Corporation in favor of the Howden-Zoelly turbine.

The 6000-kw Zoelly turbine for Manchester will be larger

than any Zoelly turbine now working. The contract includes the generator, which is a Siemens three-phase alternator, and the condensing plant, which is on the Contraflo patent.

The Latest in Electric Table Lamps.

A very convenient table lamp has made its appearance. From pictures shown in a recent press clipping, one-half of a transformer is fastened to the under side of a table while the other half of the transformer is incorporated in the base of the lamp standard. By proper transformer design, it is possible to supply the lamps on the standard with electrical energy when both parts of the transformer are placed one above the other. The advantages of such an arrangement are that no holes need be made in the table or coverings for the passage of wires; while the lamp itself can be removed from the table when so desired without disconnecting any wires.

Solderless Tap for Heavy Cables.

The accompanying illustration shows a solderless tap made by Dossert & Company, of New York City, for use on the Williamsburg Bridge. The Brooklyn Rapid Transit Company leases four city-owned 2,000,000-circ. mil cables on the structure for the purpose of feeding the elevated railway lines crossing to and from Manhattan Borough. The traffic handled by the company is usually one way; that is, in the morning the

SOLDERLESS TAP.

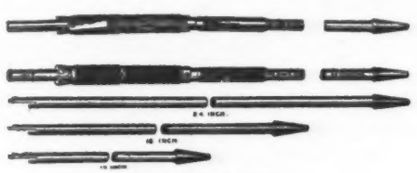
cars are crowded en route to Manhattan and come back comparatively empty, and at night the reverse is true. In this way the cables are unequally loaded. The cables are located in a very restricted space and in order to make an old-fashioned splice it would be necessary to cut the cable. Instead of this, however, 13 sets of taps are employed at intervals across the bridge to equalize the load on the cables. Cables 1 and 3 and cables 2 and 4 are joined by equalizer connections as indicated. The Dossert cable tap is used to grip the cable and a brass connector of sufficient cross-section to carry full-load current, if necessary, joins the taps. The arrangement is very compact and the cables are not cut, just enough insulation being removed to accommodate the tap.

Remarkable Aluminum Alloy.

An alloy, lighter than aluminum, which has been extensively used abroad, is being introduced in the American market by Mr. Morris R. Machol, of 32 Park Place, New York City. The alloy is called "magnalium" and is manufactured by the Magnalium Syndicate of Berlin. It is claimed to possess the following characteristics: Its melting point is between 1185 and 1250 deg. Fahr.; its specific gravity is 2.4 to 2.57, according to the percentage of the alloy; it has no odor, resists oxidation and is said to be almost unaffected by dry or damp air, water, ammonia, carbonic acid, sulphurate of hydrogen and most organic acids. It is very slowly affected by saltpeter or sulphuric acid and more rapidly by alkalies or strong alkaline solutions. Salt water attacks magnalium slightly, but when the alloy is exposed to sea water the metal may be protected by a lacquer. The alloy is said to show almost no magnetic influences, but its electric and thermal conductivity is about 56 per cent of that of pure copper. The specific heat of magnalium is 0.2185. Its color is silvery white in contrast to the grayish tint of aluminum. Magnalium, like pure aluminum, can be cast in a liquid condition, the castings machining about the same as brass and the machine surface possessing a mirror-like smoothness and silvery color. Cast in dry sand the usual quality of magnalium has a tensile strength of 18,000 lb. per square inch, and has a shrinkage of about 3¾ per cent. The tensile strength of a quality containing a somewhat smaller percentage of aluminum is about 34,000 lb. per square inch, and by proper treatment this can be increased to about 42,500 lb. Wire drawn from one quality of the alloy is said to have shown a tensile strength of 41,000 lb. per square inch and a 10 per cent reduction of area. Magnalium containing less than a certain percentage of aluminum cannot be rolled but can readily be drawn; the tensile strength of a drawn bar is 60,000 lb. per square inch and that of a tube 74,000 lb. per square inch. Another quality possessed by the alloy is that it is close grained so that it will take and maintain a polish without previous treatment. In lathe work the tool speed can be twice as great as that used on aluminum. Some alloys of magnalium are very ductile and can be forged, rolled, drawn, etc., sharing all advantages of aluminum in this respect.

Improved Extension Bit for Wiremen.

An improved extension bit possessing certain points of merit has been devised by George W. Leonard, 321 South Ann Street, Lancaster, Pa. The chuck and shanks are shown in the accompanying illustrations. Although the shanks are 12, 18 and 24 in. long, the chuck in addition is 6 in. long, so that extensions of 18, 24 and 30 in. are possible. The center ferrule is utilized



EXTENSION BITS.

for manipulating the two jaws which hold the various bits in a square socket in a manner somewhat similar to that of the ordinary brace. The jaws are small enough to follow a ⅝-in. hole, it is claimed, and the device can be taken apart easily for convenience in carrying it from place to place.

Resistance Alloy with High Melting Point.

The increasing use and popularity of electric heating and cooking apparatus have resulted in a continued improvement in the design of this class of appliances. From the central station point of view, these appliances have been recognized as excellent business getters, since they serve the double purpose of educating the public to the advantages of the electric service as well as affording a much desired addition to the day load. It is conceded by both the manufacturer and the central-station manager that the appliances furnished to the customer should be as efficient and as indestructible under normal operating conditions as it is possible to make them. One of the most serious problems met with has been the production of an indestructible resistance element. The Driver-Harris Wire Company, of Harrison, N. J., has recently placed on the market a new alloy for this purpose having excellent physical and electrical properties. The alloy is marketed under the trade name of "Nichrome." It has a tough, close-grained structure and can be worked at a high temperature without appreciable oxidation, the manufacturer claims, even when repeatedly heated and cooled. Its specific resistance is given as 95 micro-ohms per cubic centimeters and its temperature coefficient as 0.00043 per deg. C. The alloy is furnished in both wire and ribbon forms.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There is a conspicuous general improvement in sentiment and a notable growth of hopefulness in all commercial lines. The chief cause of this optimistic sentiment is the reëmployment of many laboring men. From New England, the West and the South, daily reports come of the reopening of shops. Many thousands of laborers who have been idle for months are at work again, and many operatives in the mills of New England, who had been employed on part time, are again drawing full pay. The iron and steel trade shows some slight revival; in steel bars and in the wire and tin branches of the industry especially there is marked improvement. The interference of a holiday is always a disturbing feature, and actual buying projected for July is, as a rule, deferred until after Independence Day, so that it is not surprising that orders were light during the week ended July 4. Seasonable weather influences have improved the crop situation materially, and the West is now assured of a bounteous yield. Jobbing trade continues to be of the filling-in character, although the feeling among jobbers is buoyant, owing to the undisguised depletion of retail stocks in every part of the country. Midsummer reduction sales have added to this depletion in many centers, and the general sentiment is expressed that merchants cannot long defer coming into the market for liberal stock replenishing. The large electrical concerns report the continuance of orders and an encouraging amount of new business. This condition, it is admitted, is due to small orders rather than to any extensive contracts. Both the General Electric and the Westinghouse companies are fairly well employed, and a representative of the Allis-Chalmers Company declared, that, owing to orders for mining and mill machinery, business for June was 70 per cent of normal. Business failures for the week ended July 3, as reported by *Bradstreet's*, number 236, which compare with 258 in the previous week, 135 in the corresponding week of 1907, 134 in 1906, 127 in 1905, and 172 in 1904.

THE COPPER MARKET.

The production of copper continues to exceed the demand in a manner that portends lower prices. In spite of continued effort to keep the production down approximately to the demand, and to push the consumption up to approximately the production by concessions in prices, stocks continue to increase. Figures on domestic consumption of copper for the first six months of 1908 place the amount at 140,000,000 lb. During the first quarter of the year the melting was extremely light, averaging not more than 15,000,000 lb. a month. To bring the figures up to the total named, the past three months have had to average more than 30,000,000 lb. It is estimated that about this amount was taken in June. But all of this has not been effective in reducing the surplus stocks. Although the production of copper in the Butte district was reduced considerably, it is reported that there was an increase in Arizona, Utah and other camps, so that the total for the month was little less than during the time the Butte output was normal. The Butte production for June is estimated at 13,159,000 lb., which is not 50 per cent of the output for May, and yet the total for the month is figured at 80,000,000. The total output for the first half of the year is estimated at 385,000,000, or about 65,000,000 a month. Imports during the first five months of the year, according to government returns, were about 74,000,000 lb., but over 8,000 tons arrived in June, making the total between 91,000,000 and 92,000,000 lb. Upon the reports from custom houses it is probable that imports have been about 95,000,000 lb. during the six months. The total supply from domestic and foreign sources thus has been about 480,000,000 lb.; adding stocks of 135,000,000 lb. carried on the first of year there are available supplies of 619,000,000 lb. Exports, including the estimates of shipments from Southern and Pacific ports, during the first six months of the year, have been about 367,000,000 lb. Adding this to the domestic consumption of 140,000,000 lb. makes a total apparent consumption of copper of 507,000,000 lb. The difference between this amount and the available supply would indicate that there are stocks now in the United States amounting to 112,000,000 lb. Stocks of copper in Europe are admitted to be the heaviest on record, and are estimated to be above 200,000,000 lb., which gives an available supply in the international market of possibly 325,000,000 lb. In spite of this condition, prices are held stubbornly. The pressure to sell is persistent, and here and there concessions are made until public quotations are marked a fraction lower. The truth of the matter seems to be that producers have almost reached the length they are willing to go in the downward course, and any radical measure that is taken to relieve the situation is more likely to be in the direction of curtailment than of price smashing. The copper situation appears to be too well in hand and the producers too strongly provided with money and credit for anything like a panic in prices to be possible. Closing quotations on the Metal Exchange July 6 were:

Lake	12⅝@12¾
Electrolytic	12⅜@12⅝
Castings	12¼@12⅜

The London market was as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	56 17 6	57 2 6
Standard copper, futures	57 10 0	57 15 0
Market	Firm.	Firm.
Sales of spot		400 tons
Sales of futures		700 tons

Extreme fluctuations for the year:

	Highest.	Lowest.
Electrolytic copper, spot	13¾	12¼
Lake copper, spot	13⅞	12⅜
Casting copper, spot	13½	12⅛
London, spot	£64 5 0	£56 5 0
London, futures	64 10 0	56 17 0
London, best selected	67 10 0	60 0 0

E. H. GARY OPTIMISTIC.—Before his departure for Europe on July 7, E. H. Gary, chairman of the board of directors of the United States Steel Corporation, expressed hopes of the speedy resumption of normal industrial conditions. He said that the business of the Steel Corporation had been better during the last two weeks of June than for any similar period since last October. This improvement he attributed largely to the nomination of Mr. Taft, and he felt certain that whenever the country became convinced that Taft's election was assured business would improve immediately. He said that there seemed to be a general feeling that bottom prices had been reached, and with the promise of an undisturbed future he expected active buying to begin. "The basic conditions of the country are sound," said he. "It is a day of conciliation and cooperation between competitors in business, principal and customer, the employer and the laborer, the government and the citizen, the public and the individual. The idea of co-operation prevails extensively and is here to remain. We shall all be benefited by it."

AN OAK LUMBER MANUFACTORY.—The modern sawmill plant of the Bliss-Cook Oak Company, Blissville, Ark., has a capacity of about 50,000 ft. of hard wood in a run of ten hours. An electric-light plant has been installed with a capacity of 600 lights. The company has, in and around the mill, yard, offices and town, five arc lights and about 400 incandescent 16-cp lights. Steam is furnished the Allis-Chalmers "Reliance" Corliss engine by four boilers, each 66 in. by 18 ft., the product of the Union Iron Works, of Erie, Pa. The boilers are fed by the blowpipe system, which collects shavings and sawdust from the flooring machines and carries this refuse to the boiler-room.

SECOND-HAND MACHINERY.—The F. Bissell Company, Toledo, Ohio, has announced its entry into the second-hand machinery field by issuing "The Little Book of Real Bargains," containing a long list of new and used machinery, which publication will be issued every month. While this department of the Bissell Company's business has been in existence for a good many years, it was not until the last year that the firm entered into the second-hand machinery business on a large scale. While effort was at first confined to a few States, the department has developed to such an extent that its conduct on a much broader basis in the future became necessary.

FLAMING ARCS FOR STORES.—The most progressive merchants are always on the look-out for improved methods for economically displaying and advertising their goods. Among the foremost of this class are F. W. Woolworth & Company, who are operating something like three hundred "Five" and "Ten Cent" stores in leading cities throughout the United States. They adopted, a long while ago, the Excello flaming arc lamp for exterior illumination, and were therefore able to plan their new store in Jersey City, 145 Newark Avenue, in the light of their past experience. The front of the store is so constructed that their two enormous show windows are illuminated by two Excello flaming arc lamps hung outside over the sidewalk, and this is so well done that every article in the windows is beautifully displayed without any other illumination whatever. The lamps thereby accomplish the double purpose of attracting the attention of the people in the street to the store, and illuminating the goods displayed in the show windows. The interior of the store is illuminated by 19 "Trulite" lamps. This style of lamp is also being put on the market by the Excello Arc Lamp Company, No. 30-32 East 20th Street, New York City. The "Trulite" lamp is much smaller than the Excello flaming arc, and is designed more especially for indoor lighting. The 19 lamps installed in the Woolworth store are of special interest as they are adapted for operation by alternating current. The "Trulite" lamps have been furnished for some time for operation on direct current, but the company has had a great many inquiries for the lamp for use on alternating current, and have now been able to perfect their lamp to a point where they are willing to furnish it to their customers for such a purpose.

BIG TRADING COMPANY IN JAPAN REORGANIZED.—Henry B. Miller, United States Consul General at Yokohama, Japan, has sent to the State Department the following account of the reorganization of the Mitsui company, which he describes as the largest commercial house in Japan: "It appears that the Mitsui company has under consideration a scheme to reform the organization of its business, because of the large extension of its operations since the war. Since the war came to an end the company has largely extended its business in Europe, America, Australia and Asia, and for a time the annual amount of business done exceeded $100,000,000 gold. An undertaking handling such an enormous trade is seldom to be found. The branch offices and agencies scattered over the world number 76, and the firm's employees number 1300. It is doubtless in consequence of the enormous size of its transactions that the financial depression has been felt so severely by the Mitsui company—the reaction on the company during the period of depression having been as powerful as the extension of its business was great during the boom."

INDUCTION METER PATENT COMBINATION IN FRANCE.—A circular letter to French central stations announces that four companies manufacturing meters have entered into an agreement concerning patents, and that hereafter all meters manufactured subject to these patents will be identified by a mark, consisting of the initials of the several companies inside a circle. These companies are the Westinghouse Electric Company, Ltd., Paris; Allgemeine Elektricitäts Gesellschaft, Berlin; Compagnie Pour La Fabrication des Compteurs et Materiel d'Usines à Gag, Paris; Compagnie de Construction Electrique d'Issy-les-Moulineux. Accompanying the notice is a sheet giving a list of the patents on meters issued in various European countries and controlled by the several companies. There are 37 German, 27 French, 16 English, 22 Italian patents, and smaller numbers for the other European countries.

BUILDING MATERIAL EXHIBITION.—The Building Trade Employers' Association, of 30 West Thirty-third Street, New York City, has opened a permanent exhibition on the second floor of the Builders Exchange at that address, for the display of the latest and most approved appliances, devices and material used in construction. A number of leading and well-known architects have given this exhibition their approval, and it is visited daily by many who desire to save time and money when studying these subjects. It seems a much better plan than loading a variety of samples into architects' offices where they accumulate and become a nuisance. A neat pamphlet and floor plans have been issued, and Mr. James J. Conor has been made manager of the exhibition department, in charge of the renting of space and other details.

NEW HAVEN ROAD ELECTRIFICATION.—T. E. Byrnes, vice-president of the New York, New Haven & Hartford Railroad, has stated that the company would push the electrification of all its lines as soon as the officials are satisfied that the present system is a success. He said the suburban lines of large communities would be equipped first, and that the road would be taken up section by section.

Financial Intelligence.

THE WEEK IN WALL STREET.

The week ended July 6 was one of the dullest which Wall Street has ever known. The period immediately preceding the Independence Day holiday was marked by the apathy of traders and by low records in the volume of transactions. The oppressive weather in New York, the approach of the holiday, the status of general trade, and the approach of the convention at Denver contributed to check trading. Those conditions which usually control the market were not unfavorable. Interest payments, except in a few cases, which had been expected, were met promptly; crop reports from the West were entirely satisfactory, and the government report of June 25 promised a rather unexpectedly large cotton yield; money was extremely easy, and there were many expressions of hope for good commercial trade. Among the minor matters which may have discouraged some traders were the appointment of receivers for the United Box Board Paper Company, and the omission of interest payments on the Wabash Railroad A and B debenture bonds. In the financial district many signs of a return to normal conditions are reported. The gradual re-employment of labor all over the country is more appreciated by the professional of the Street than the spectacular opening of doors for 20,000 men at a single factory. A turn for the better is anticipated in railroad earnings, as the movement of a portion of the cereal crop is at hand, and this is expected to bring in returns rapidly owing to the rigid economies that have been practiced. One feature that is taken to be particularly encouraging in Wall Street is the increase in the number of stockholders reported by many of the best railroads and industrials. The number of the New York Central & Hudson River Railroad shareholders, for instance, which was 16,445 last September, has increased to 22,098; the United States Steel Corporation has added 35,000 shareholders, the Pennsylvania Railroad 15,000, and many others in less degree. Small investors have been availing themselves of opportunities to buy good securities at bargain prices. On July 6, when the market reopened after the holiday, there was a better feeling, prices were buoyant, and sufficient activity developed in trading to give satisfaction to the brokers. Union Pacific, Northern Pacific, Reading and American Smelting were exceptionally active. In these and several other of the more important issues the timid shorts sought cover. Money conditions were practically unchanged. Call loans were quoted at 1 to 1¼ per cent, with the close at the lower figure, and 90-day funds were plentiful at 2 to 2¼ per cent. The quotations are for the close on July 6:

NEW YORK.

	June 29.	July 6.	Shares Sold.		June 29.	July 6.	Shares Sold.
All.-Ch.	11	11½	3,485	Int.-Met., com.	10¾*	11¾	3,600
All.-Ch., pfd.	34⅜	35⅛	2,776	Int.-Met., pfd.	28⅜*	31¼	6,000
Amal. Cop.	66⅝	68	40,750	Mackay Cos.	65	65	139
Am. D. T.	39	39*	——	Mack'y Cos., pfd	64½	65¾*	——
Am. Loc.	48	49½	7,355	Met. St. Ry.	25	25*	——
Am. Loc., pfd.	101½	101¼	1,155	N.Y.&N.J.Tel.	105⅛*	107½	35
Am. Tel & Cbl.	67*	64½	100	Steel, com.	38	38¾	76,270
Am. T. & T.	118⅝	115½	1,800	Steel, pfd.	101¼	104⅝	8,933
B. R. T.	48	49	10,355	W. U. T.	53	54½	500
Gen. Elec.	134*	134	150	West'h, com.	55	55⅝	5,335
Hud. R. Tel.	—	—	——	West'h, pfd.	80	79	200

PHILADELPHIA.

	June 29.	July 6.	Shares Sold.		June 29.	July 6.	Shares Sold.
Am. Rys.	44¼	44⅜	——	Phila. Elec.	9½	9⅜	——
Elec. Co. of A.	10½	10¾	——	Phila. R. T.	15⅝	17⅛	——
Elec. Stor. B'ty	30¾	32	——	Phila. Traction	87½	88	——
E. S. B'ty, pfd	49*	49*	——				

CHICAGO.

	June 29.	July 6.	Shares Sold.		June 29.	July 6.	Shares Sold.
Chi. City Ry.	190*	190*	——	Met. El., com.	17*	17*	——
Com. Edison	98	100¼	——	Met. El., pfd.	50*	50*	——
Chi. Subway	10	18½	——	Nat'nal Carbon	70*	70¼*	——
Chi. Tel. Co.	133¼	135½	——	Nat. Carb., pfd.	112	112*	——

BOSTON.

	June 29.	July 6.	Shares Sold.		June 29.	July 6.	Shares Sold.
Am. Tel. & Tel.	118⅜	116¼	——	Mass. E.R., pfd	46	46¼*	——
Comb'ind Tel.	—	108¾	——	Mex. Tel., pfd.	—	—	——
Edison El. Ill.	207¾	—	——	N. E. Tel'p.	113	112	——
Gen. Elec.	134	134	——	W. Tel. & Tel.	6*	6*	——
Mass. Elec. Ry	10	10	——	W. T.&T., pfd.	65	65	——

*Last price quoted.
Shares sold are for week June 29 to July 6.

ANNOUNCEMENT REGARDING WESTINGHOUSE SUBSCRIPTIONS.

The Readjustment Committee of the Westinghouse Electric & Manufacturing Company has issued a report in the form of a circular to the depositors under the readjustment plan, and to creditors, which sets forth the condition of the subscriptions to the $10,000,000 new stock required under the merchandise creditors' plan. The circular is signed by James N. Jarvie, chairman, and the other members of the committee. The document shows reports from the Stockholders' Committee, the Merchandise Creditors' Committee, the Security Investment Creditors' Committee and the Employees' Committee. The total subscriptions from all sources, including the underlying subscription of Mr. George Westinghouse, amount to $9,770,862. The figures in detail are:

By merchandise creditors, payable by the surrender of claims, $4,135,912.

By employees of the company, and others, payable in cash at the rate of 10 per cent per month, beginning with July, 1908, $595,650.

By stockholders, payable in cash at the rate of 25 per cent on or before June 20 ($544,080 in cash having actually been paid to the depositaries of the committees), and the balance in installments, $2,214,300.

By the Security Investment Company, conditional subscriptions payable in cash in installments, $1,325,000.

(The above subscription is to be secured by underlying subscriptions of creditors of the Security Investment Company, chiefly blanks.)

Subscription secured by underlying subscription of Mr. George Westinghouse, $1,500,000.

Total of Security Investment Company subscriptions, $2,825,000.

The $2,825,000 of subscriptions from the Security Investment Company are conditional upon the consummation of the plan for the extension of the debt of that company, and a portion of such subscriptions are to be further guaranteed.

Total subscriptions from all sources (including conditional subscriptions of Security Investment Company), $9,770,862.

Of this amount the subscriptions payable in cash, as distinguished from those payable by the surrender of claims, aggregate $5,634,950.

These figures indicate that while the merchandise creditors, over-subscribed by $135,912, the $4,000,000 they had agreed to take, subscriptions on the $6,000,000 allotted to the stockholders, the Security investment creditors and the employees are $365,050 short of the desired amount. The net shortage, however, under the entire plan is only $229,138. The readjustment committee announces that upon the united request of the various committees which had secured the subscriptions and by reason of the substantial progress made, it had been determined to extend until Sept. 1, the time for securing the remaining subscriptions. In this connection, the circular says:

"Upon the strength of the progress reported by these committees, and upon statements of account furnished by the auditor of the company, approved by Haskins & Sells, and after full consideration of the existing conditions, this committee, at a meeting held on June 24, announced its willingness to cooperate and to accept on September 1 the merchandise creditors' plan, upon condition, however, that at least $10,000,000 of subscriptions for new stock and all payments of matured installments thereunder be made and be in hand on September 1, 1908, and that certain of such subscriptions be satisfactorily guaranteed; that the assents of the holders of the bank debt to exchange their claims for the securities hereinafter mentioned be in hand by September 1, 1908, and that all the other conditions of the plan be complied with. The conditions also include the election and provision for the continuance of a Board of Directors satisfactory to the Readjustment Committee, either by proxy committee or otherwise, so as to insure a conservative management of the future financial and business affairs of the company.

"This committee recommends and requests the bank creditors to agree to accept in exchange for their claims one-half of the par value thereof in convertible sinking fund bonds of the company (of the present issue), at par, and for the other one-half either (*a*) 5 per cent notes of the company in three equal amounts, maturing respectively in four, five and six years from their date, to the extent of 30 per cent of the face value of their claim, and for the balance of their claim 'assenting stock' of the company at par, the creditor to have, however, the privilege of taking a larger amount in stock and a lesser amount in obligations; or (*b*) at the option of the creditor in respect of the one-half of the claim not covered by convertible sinking fund bonds, 5 per cent notes of the company maturing 15 years from their date. Interest to be payable on all notes semi-annually."

The circular advises the creditors to be satisfied with the proposed debt reduction and with the increase of working capital by $6,000,000, and declares that the consummation of the plan will terminate the receivership and obviate the possible necessity of a sale. In conclusion the circular states:

"It should be understood, however, that the proposed readjustment under the merchandise creditors' plan, dealing as it does only with existing difficulties, is not such a readjustment or reorganization as was contemplated by this committee. It should be added, as has been stated to the other committees, that unless the merchandise creditors' plan and all of its terms and conditions, and the additional conditions set forth, are complied with by September 1, this committee must proceed with a readjustment or reorganization of the company, which, if necessary, will include a judicial sale of the entire assets and property. In such a readjustment or reorganization a considerable portion of the debt would in all probability be represented by a preferred stock, and shareholders would be called upon to subscribe, through an assessment, an amount necessary to thoroughly rehabilitate the company."

In Wall Street the report of the committee was looked upon as meaning that practically every obstacle to the success of the reorganization plan would be removed.

DIVIDENDS.

Scranton (Pa.) Electric Company, preferred, quarterly, 1½ per cent, payable July 1.

Manchester (N. H.) Traction, Light & Power Company, quarterly, 2 per cent, payable July 15.

Butte (Mont.) Electric & Power Company, common, quarterly, 1½ per cent, payable July 6.

Osceola Consolidated Mining Company, Boston, semi-annual, 8 per cent, payable July 29.

National Light, Heat & Power Company, quarterly, 1¼ per cent, payable July 1.

Edison Electric Illuminating Company, Boston, quarterly, 2½ per cent, and 1 per cent extra, payable July 1.

Standard Underground Cable Company, of Pittsburg, quarterly, 3 per cent, payable July 10.

Electric Company of America, Philadelphia, semi-annual, 3½ per cent, payable August 4.

Automatic Telephone Company, New Bedford, Mass., quarterly, 1½ per cent, payable July 15.

New Hampshire Electric Railways Company, Haverhill, Mass., semi-annual, 1 per cent, payable August 1.

HELION LAMP STOCK.—The W. L. Tucker Company, brokers, of New York, are offering stock in the Parker-Clark Electric Company, which is stated to be the owner of the Helion lamp and other valuable patents. The statement is made that the company is capitalized at $1,000,000 common stock, $300,000 of which is offered for sale. The claims are made that the lamp has an efficiency of one watt per candle, will stand an overload of fully 50 per cent, and has an endurance and life equal to any other lamp. It is stated that the largest electric lamp factory in America could be made into a Helion factory at an estimated outlay of only $12,000.

MILLIKEN BROTHERS REORGANIZATION.—The receivership of Milliken Brothers, Inc., which has been in existence since June 10, 1907, has been extended until Aug. 1, when it is expected that the reorganization plans will be completed. On June 26, 1908, the receivers held $531,973, with accounts and notes receivable of $159,619. The interest on the corporation's outstanding bonds has been met regularly by the receivers, and in spite of the business depression the concern has done almost as much business as in the 12 months preceding the appointment of the receivers.

SYRACUSE INDEPENDENT TELEPHONE PLANT SOLD.—The plant of the Independent Telephone Company, of Syracuse, N. Y., was sold July 3 at receiver's sale to Roy McCanne, of Rochester, N. Y., for $25,000. Mr. McCanne bid in the property in behalf of the reorganization committee of the United States Independent Telephone Company. The sale was made subject to a mortgage of $1,250,000. The company was organized in 1905.

METROPOLITAN STREET RAILWAY LEASES OF UNDERLYING LINES CANCELLED.—Acting upon an application made by Adrian H. Joline and Douglas Robinson, receivers of the New York City Railway Company and the Metropolitan Street Railway of New York City, Judge Lacombe, of the United States Circuit Court, has rendered decision canceling the leases of the Central Park, North & East River Railroad, known as "the Belt Line," which includes the Fifty-ninth Street cross-town service, and also the Twenty-eighth and Twenty-ninth Street cross-town lines. The effect of this decision is that these roads will be returned to the owners for operation, and that transfers between these lines and branches of the Metropolitan system will be abolished. As the companies originally owning the lines now to be segregated have been dormant for many years, and own neither equipment nor power stations, cancellation of the leases may mean the discontinuance of the service unless some new operating arrangement can be made. The application was made by the receivers on the ground that the roads were not earning enough to pay the rental charges, and were a loss to the New York City Railway Company, which the receivers did not feel that they had a right to continue. Judge Lacombe suggested June 30 as the date for the cancellation of the leases to become effective, but as he added that a proper regard for the convenience of the traveling public must be observed, it is understood that a temporary running arrangement, which Judge Lacombe, in his decision authorizes, will be made. Under the lease the New York City Railway Company agreed to pay a rental equivalent to 9 per cent on the stock, which now amounts to $162,000 a year. The lease was to run for the unexpired term of the charter, which was issued June 5, 1860, to run for 100 years. The gross earnings of the lines for the year ending March 31, were $749,624, and the total operating expenses $607,396, besides which there were paid for taxes and for other purposes enough to make the total disbursements of the lessee $650,199, which does not include the franchise tax now in litigation. Judge Lacombe finds that irrespective of the franchise tax, the net earnings amount to only $99,425, and that the net loss annually to the lessee is more than $60,000. However, he says, heavy construction expenses must be incurred in the near future, and the franchise taxes must eventually be paid. The stockholders of the crosstown companies have been called to meet July 10 for the purpose of organizing a new board of directors and determining as to the future of the properties. Judge Lacombe also rendered a decision denying the application of the Farmers' Loan & Trust Company, New York, for a receiver for the Central Park, North & East River Railroad in a suit for $1,200,000 on the foreclosure of a mortgage.

INTERNATIONAL STEAM PUMP COMPANY.—The annual report of the International Steam Pump Company shows largely decreased earnings and heavy reduction in gross business. The total income for the 12 months ending March 31, was $2,226,253, a decrease of $319,652 from the previous year. After charging off depreciation and interest a balance was left of $2,040,397, a decrease of $303,506. After paying the preferred dividends a surplus was left of $363,745, a decrease of $303,579. The final surplus of the company after all adjustments were made was $2,592,869, an increase of $41,163 over the final surplus of the previous year. The surplus available for dividends on the common stock was $363,745, which is equal to 2.04 per cent on the outstanding issue, as compared with 3.7 per cent last year. In his report to the stockholders President Dunn says: "During the first six months of the fiscal year, namely, from April to October, 1907, the orders booked equaled in amount the average for the preceding year, which was the largest year of our company. For the last six months of the fiscal year, owing to the financial disturbance which affected the country at large, the orders booked fell off about 40 per cent. There were unfilled orders on the books at March 31, 1908, amounting to $4,000,000. The business of the Power & Mining Machinery Company, at Cudahy, Wis., shows a substantial gain over the former years, resulting in a profit largely in excess of the amount guaranteed."

UNITED STATES SMELTING & REFINING COMPANY.—A director of the United States Smelting & Refining Company says that business is showing considerable improvement within the last few months and that the company is more than earning its dividends on the preferred and common stocks. This director is quoted as follows: "The United States company is now outputting 2,000,000 lb. of copper per month from the Mammoth smelter, of which 1,500,000 lb. represent Mammoth production, and 500,000 lb. come from the Centennial-Eureka ores, which are now being shipped to California. The principal values of the Centennial-Eureka ores, however, are gold and silver. This copper is probably the cheapest produced in the United States. Leaving out of consideration the rich Centennial-Eureka ores, the Mammoth Company has shown ability to produce its copper at as low a cost as 7½ cents, crediting gold and silver values against the cost of the copper. The capacity of the Mammoth smelter is now 1500 tons of ore per day."

EARNINGS OF BELL COMPANIES ENCOURAGING.—The income account of the associate operating companies of the Bell organization for April and the first four months of 1908 shows total net earnings for the four months for interest and dividends of $11,788,900, an increase of $1,142,600 or 10.7 per cent over the same period of 1907. The balance for dividends was $9,173,500, an increase of $779,500 over the four months of 1907. The figures in detail are:

	April, 1908.	First four months, 1908.	Increase over first 4 months, 1907.
Telephone revenue	$9,882,200	$38,924,400	$2,601,000
Operating and maintenance	7,143,500	28,771,500	1,616,400
Balance from operation	2,738,700	10,152,900	984,600
Sundry earnings (net)	399,800	1,636,000	158,000
Total earnings (net)	3,138,500	11,788,900	1,142,600
Interest charges	641,800	2,615,400	363,100
Bal. available for dividends	2,496,700	9,173,500	779,500
The maintenance and taxes items (included above) are:			
Maintenance	$2,802,600	$11,149,800	$1,083,300
Taxes	416,400	1,652,200	183,400
Total	3,219,000	12,802,000	1,266,700

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The report of the American Telephone & Telegraph Company for May, and the five months ended May 31, shows increases in both gross and net earnings. Gross earnings for May were $1,837,529, an increase of $286,685 over May, 1907; net earnings were $1,686,461, an increase of $307,100 over the corresponding month of last year. For the five months of 1908 the gross earnings were $12,593,351, as against $10,627,158 in the corresponding period of 1907. The net earnings were $11,723,172 in the 1908 period, against $9,776,560 in the five months of 1907. The surplus on the five months' business, after meeting interest and the dividends of April 15, was $5,448,476, an increase of $1,163,390 over the surplus at the corresponding time last year. The expenses for May decreased $20,405 under last year, while the expenses for the entire five months increased $19,581.

BROOKLYN SUBWAY POSTPONED.—Justice Blanchard, of the Supreme Court of New York, has heard arguments and taken under advisement an application to continue the temporary injunction restraining the Board of Estimate from awarding contracts for building the proposed Fourth Avenue subway in Brooklyn. The effect of this proceeding is to delay action on these contracts until fall, as the Board of Estimate will take its summer vacation before a ruling on the injunction will be received. The board has under consideration the question of referring the subway question to a referee to determine whether the city's debt limit has been reached.

UTAH COPPER COMPANY IN GOOD CONDITION.—It is announced from the general office of the Utah Copper Company, in Boston, that beginning in September the company expects to pay regular quarterly dividends at the rate of 20 per cent per annum on the par value of the stock. The management says that the property will turn out 50,000,000 lb. of copper a year. If these expectations are realized the company will be the fifth in point of production in the United States, following the Anaconda, Calumet & Hecla, Boston & Montana and Copper Queen.

MUNICIPAL TRACTION COMPANY SHOWS LOSS.—The Municipal Traction Company, of Cleveland, which is operating the urban car lines of that city under the plan devised by Mayor Johnson, reports a deficit of $54,916 for May. It is claimed by the management that the shortage is due largely to a strike, and that a profit would have been shown had it not been for this development.

NATIONAL CARBON COMPANY.—Official denial is made of the report that the National Carbon Company is contemplating an issue of 5-per-cent bonds to be used in retiring the $4,500,000 preferred stock. Earnings of the company since Feb. 1 have been at the rate of about $900,000 net per annum, which compares with $924,801 for the fiscal year ended Jan. 31, 1908.

GENERAL NEWS

Late items are printed unclassified at end of department

Construction News.

COLUMBIA, ALA.—It is reported that Charles H. Davis is contemplating developing a water power of 800 hp. Electrical equipment for 500 hp will be installed at first.

OPELIKA, ALA.—The Alabama Railway & Electric Company contemplates awarding contracts for building 30 miles of track in the near future. J. C. Chapman, of Atlanta, Ga., is vice-president.

WILLIAMS, ARIZ.—The Grand Canyon Electric Light Company has decided to apply to the City Council for a franchise to operate a water works system in connection with its electric light plant. The city has had under consideration the question of purchasing the electric light plant of the company, including the Caufman dam and site and the Nellis water system, for $75,000, and to expend $25,000 for improvements. It was proposed to bond the city for $100,000, but as it did not meet the approval of the majority, the company has decided to operate the water works system if granted a franchise.

ESCONDIDO, CAL.—The Escondido Mutual Water Company is considering a project to utilize the water of its reservoir to generate electricity. It is proposed to locate the plant at a point below the dam where a fall of about 450 ft. can be obtained. The water will afterward be used for irrigation purposes. The cost of the plant is estimated at $30,000. The plant will furnish electricity for lamps and motors to the entire valley. J. L. Van Derveer is secretary.

GEYSERVILLE, CAL.—The farmers between Geyserville and Lytton have organized an electric light and power association and will make arrangements to furnish electricity for lamps and motors to all the farmers along the country road between the two villages, a distance of about 4½ miles. It is proposed to erect their own transmission line and secure electrical energy from the plant of the Cloverdale Light & Power Company, of Cloverdale, Cal. F. Huebner, of Healdsburg, will have charge of the construction of the transmission line.

INDEPENDENCE, CAL.—Plans are being made by the Four Metal Mining Company for the construction of a power house and pipe line, work on which will begin as soon as permission is received from the Forest Service. It is hoped to have the entire plant, consisting of power plant, transmission lines, smelter and aerial tram, completed this season.

SAN FRANCISCO, CAL.—The Consumers' Light & Power Company has placed contracts for machinery and electric equipment for a direct-current central station plant, to be installed in the basement of the new Whitney Building on Geary Street, as follows: For four engines with a total of 750 horse-power to Hunt, Mirk & Company; four 220-volt generators to the Westinghouse Electric & Manufacturing Company; for boiler plant, including five large boilers, to Charles Moore & Company.

STOCKTON, CAL.—The Central California Traction Company is considering extending its system to Sacramento and also to Modesto. W. Arnstein, of San Francisco, is secretary.

VENTURA, CAL.—The Ventura Industrial-Securities Company, which has taken over the proposed Ventura Terminal Railway Company, will commence preliminary work at once on the electric railway from Ventura to the cement quarries in the Matilija, a distance of 22 miles. The company also proposes to construct a five-mile branch to Nordhoff.

BOULDER, COL.—The Board of Regents has appropriated $10,000 to install a new power plant at the University of Colorado. The equipment will include a boiler, engine and generator with switchboard and other apparatus necessary for accurate tests by the electrical engineering students. The system is being changed from direct-current to three-phase alternating-current.

DENVER, COL.—The Lacombe plant of the Denver Gas & Electric Company was badly damaged June 24 by the bursting of a large fly-wheel, causing a loss of between $8,000 and $10,000.

LONGMONT, COL.—The City Council is considering the question of establishing a municipal electric light plant. The franchise of the local company expires in 1912.

WATERBURY, CONN.—The Southern New England Telephone Company expects to erect a new toll line between Waterbury and Newton. The company is now rebuilding portions of its toll lines between Waterbury and Danbury.

WINDSOR LOCKS, CONN.—Negotiations are under way for the purchase of the franchise of the Windsor Locks & Rainbow Street Railway Company, which authorizes the company to build an electric railway from Windsor Locks to Rainbow, where connection can be made with a suburban branch of the Hartford Street Railway system. Boston capitalists are interested in the project.

WASHINGTON, D. C.—Bids will be received until July 14 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing supplies at the navy yards and naval stations as follows: Boston, Mass.: Schedule 39—145 electric motors. Portsmouth, N. H.: Schedule 40—heavy engine lathe; motor-driven universal radial drill. Also until July 21 as follows: Mare Island, Cal.: Schedule 17—seamless steel tubing for steel pipes. Schedule 43—electrical supplies. Applications for proposals should designate the schedules desired by number. E. B. Rogers is paymaster-general, U. S. N.

COLLEGE PARK, GA.—The City Council has presented a bill to the State Legislature to amend the charter of the city, permitting it to install an electric light plant, water works and sewerage systems. E. O. Williams is city clerk.

BELLEVUE, IDAHO.—The hydro-electric power plant of the Idaho Consolidated Mines Company is completed and will be placed in commission as soon as the company's new mill is completed. The plant has an output of 800 horse-power installed in two units of 400 horse-power each, which will furnish electricity for operating the mill and mines at Bradford, near Bellevue.

TWIN FALLS, IDAHO.—The Great Shoshone & Twin Falls Water & Power Company is making plans to build a new hydro-electric plant with an output of 37,500 kw and erecting a 60-mile transmission line. D. C. MacWatters, of Milner, Idaho, is manager.

ELGIN, ILL.—The contract for the construction of the substation of the Aurora, Elgin & Chicago Railroad Company to be located on Grove Street has been awarded to L. E. Palm, of Elgin, for $13,900. E. C. Faber is general manager of the railway company.

HARRISBURG, ILL.—Extensive improvements will be made to the electric light plant and water works system of the People's Water & Light Company, which will include the reconstruction of the transmission lines.

HAVANA, ILL.—Arrangements have been made for rebuilding the plant of the Havana Electric Company, which will include the installation of new machinery. W. P. Herget is president.

HOOPESTON, ILL.—The Hoopeston Gas & Electric Company has recently installed a 300-hp Munzel gas engine and a 200-kw, Westinghouse generator in its power plant. For the present the company will hold in reserve for use in emergency a 56-kw dynamo and one of the old Ideal engines and Stirling boilers. The power house will soon be remodeled throughout and the lighting circuits throughout the city will be rebuilt during the summer.

JOILET, ILL.—We are informed that the Joilet & Southern Traction Company will build extensions to Blue Island and Chicago Heights this year. The company at present has two car lines under construction, one to Frankfort, a distance of four miles, and the other to Mokena, four miles in length.

PARIS, ILL.—The Paris Traction Company is making arrangements to extend its railway system to Ridgefarm. C. F. Probst is general manager.

PAXTON, ILL.—The Paxton Electric Company is planning to install an ice plant in connection with its electric plant. J. W. M. Burton is manager.

ROSSVILLE, ILL.—The Rossville Electric Light Company has installed a 40-kw generator and a 50-hp engine in its plant, and will hereafter furnish an all-night lighting service throughout the town.

SYCAMORE, ILL.—The City Council has granted a franchise to the the Exchange Telephone Company to construct and operate a telephone system in Sycamore.

BOONEVILLE, IND.—The Chandler Telephone Company contemplates installing a telephone system in Booneville and establish connections between Luce and Ohio Townships, and also promises service to Indianapolis and Louisville.

GARY, IND.—The Co-operative Construction Company has completed arrangements with a syndicate composed of New York, N. Y., Chicago, Ill., and South Bend, Ind., capitalists, whereby sufficient capital is guaranteed to construct and complete the remaining lines of the Gary & Interurban Railway system. The power plant has been completed and the street cars on Broadway have been put in operation. The additional capital will be used for the construction of the Fifth and Eleventh Avenue car lines, to connect with East Chicago and Tolesto̲n. F. N. Gavit, of Whiting, Ind., is president, and C. W. Chase, of Chicago, Ill., secretary and treasurer.

HOPE, IND.—The Central Union Telephone Company has been granted a franchise to establish and operate a telephone system in Hope.

SEYMOUR, IND.—The Indiana Public Utilities Company, recently incorporated, has been granted a 20-year franchise to furnish electricity and gas in the city. It is said that the new company will make an effort to secure the gas and electric plants, now in operation, owned by the Seymour Gas & Electric Light Company, now in the hands of a receiver.

CLEAR LAKE, IA.—The Clear Lake Independent Telephone Company has installed a new switchboard and contemplates other extensions and improvements to its system.

DES MOINES, IA.—The property of the Mitchellville Telephone Company and the Farmers' & Merchants' Telephone Company, of Prairie City, have been purchased by the Iowa Telephone Company.

EARLHAM, IA.—The citizens on June 20 voted to issue $17,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

HAMILTON, IA.—The Chicago, Ottumwa & Western Railway Company has commenced work on the preliminaries for its proposed electric railway from Hamilton to Ottumwa and Des Moines. The present plans call for the overhead trolley system, and it is proposed to erect a power plant at Hamilton. T. J. Avery, of Hiteman, Ia., is president and secretary.

KEOKUK, IA.—Application has been made by Hugh Cooper for a franchise to construct a street railway in Keokuk.

OSKALOOSA, IA.—The Home Telephone Company is planning additional construction work to its system in this city, which will involve an expenditure of about $20,000.

OTTUMWA, IA.—Extensive improvements are contemplated by the Home Telephone Company to the local system, to cost about $50,000.

FORT SCOTT, KAN.—The Fort Scott Gas & Electric Company contemplates making extensive improvements to its system this summer, including the erection of 16 miles of transmission lines (alternating-current), and the installation of a large generator to supply electrical energy for the street car service.

GARDEN CITY, KAN.—A franchise has been granted to the People's Telephone Company to construct telephone lines in Garden City.

TOPEKA, KAN.—The Topeka Railway Company is changing the route to Oakland which will necessitate the construction of five miles of new track. The company is also planning to build double-track extensions to two other car lines. F. G. Kelly is secretary.

WICHITA, KAN.—The Wichita Railroad & Light Company is installing a reserve generator for the arc-lamp circuit. H. E. Chubbuck is manager.

MORGANFIELD, KY.—The Morganfield Light & Power Company is planning to install a 100-kw, 550-volt, direct-current generator this fall to furnish electricity for motor service, both alternating-current and direct-current. F. W. Gilbert is manager.

DIMONDALE, MICH.—The Council has entered into a contract with the Michigan Power Company to furnish the village with electricity for lamps and motors.

GRAND LEDGE, MICH.—Extensive improvements are contemplated by the Citizens' Telephone Company to its plant in this city.

MONTAGUE, MICH.—The Lake Shore Telephone Company is planning extensive improvements to its plant in Montague, which will involve an expenditure of about $10,000. The company also plans to make many improvements to its system in Pentwater.

MORLEY, MICH.—W. F. Turner, of Morley, writes that it is proposed to construct a power plant and dam in Morley, to cost about $100,000. E. A. Bending, of Grand Rapids, is engineer.

TRAVERSE CITY, MICH.—The Leland Dam has been purchased by Francis E. Hatch, superintendent of the Pellston Light & Power Company, and it is proposed to construct a power plant to furnish electricity to light the villages of Leland, Northport, Sutton's Bay and Provemont.

BATTLE LAKE, MINN.—Plans are being made by the Battle Lake Mutual Telephone Company to construct a new exchange building in this city and the erection of about 40 miles of rural telephone lines.

BUHL, MINN.—Bids will be received by the Village of Buhl until July 21 for additions and improvements to the municipal electric light plant and water-works system consisting of a 75-kw, 220-volt, direct-current dynamo, direct connected with three-wire compensator set, or a three-wire generator switchboard; two 150-hp high pressure boilers; one 125-hp high or medium speed automatic engine, surface condenser, boiler-feed pump, closed heater and piping, all complete; also for construction of brick building 48 ft. x 73 ft. Oscar Claussen, German-American Bank Building, St. Paul, Minn., is consulting engineer.

OWATONNA, MINN.—The Northwestern Telephone Company contemplates the construction of a telephone line between Owatonna and Deerfield.

STURGEON LAKE, MINN.—The Pine County Telephone Company has been granted permission to operate a telephone system in Sturgeon Lake.

WELCOME, MINN.—It is reported that an electric light plant will be installed in Welcome.

COLUMBUS, MISS.—The Columbus Railway, Light & Power Company contemplates installing a 350-hp water tube boiler in its plant in the near future. S. W. Greenland is general manager.

VICTOR, MONT.—An electric light company has been formed to construct an electric light plant to furnish electricity for lamps and motors in Victor and Stevensville. Work has commenced on the construction of the plant, which will be located on the Bitter Root River in Victor. The company expects to have its plant in operation by fall.

FAIRVIEW, NEB.—A movement is on foot to construct a large power plant for the distribution of electricity throughout the mining district at Chalk Mountain, between Wonder and Fairview. R. H. McLaughlin, of Fairview, and Roy Ridge, of Reno, Nev., are interested in the enterprise.

LODGE POLE, NEB.—The plant of the Lodge Pole Telephone Company has been purchased by C. F. Mettey, who it is said plans to make extensions and improvements to the system.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company is extending the street car line from Courtland Beach to the club house of the Omaha Rod and Gun Club.

PENDER, NEB.—The citizens have voted to issue $7,000 in bonds, the proceeds to be used to establish a municipal electric light plant.

BERLIN, N. Y.—The Berlin Electric Light, Heat & Power Company has been granted permission by the Public Service Commission to commence work on the construction of its plant under the franchise granted by the town of Berlin, and to issue $17,500 in capital stock to cover the cost of the plant.

BROADALBIN, N. Y.—The Broadalbin Electric Light & Power Company contemplates building a dam and power station in the fall or next spring. The plant will have an output of 400 kw. William Pierson Judson is president.

BROOKLYN, N. Y.—The contract for installing electric equipment in Public School 93, Borough of Brooklyn, was awarded to Reis & O'Donovan, New York City, for $6,939, by C. B. J. Snyder, superintendent of school buildings.

BUFFALO, N. Y.—The City and County Hall Commissioners have recommended that an electrical engineer be employed to prepare plans and submit bids for installing an electric lighting plant in the city and county hall building. The cost of the plant is to be equally divided between the city and the county.

BUFFALO, N. Y.—C. H. Bierbaum, consulting engineer, who has been engaged to look into the lighting system of the Seventy-fourth Armory, has advised the Board of Supervisors to install an electric plant in the armory, the equipment to consist of a 100-kw generator and a 150-hp gas engine.

GLENS FALLS, N. Y.—The Mohawk Power Company has applied to the Public Service Commission for permission to issue $100,000 in capital stock, the proceeds to be used to develop the water power of the Mohawk River to generate electricity.

NEW YORK, N. Y.—Bids will be received until July 13 by C. B. J. Snyder, superintendent of school buildings, for alterations and additions to the electric bell and electric light systems in Public Schools 18, 54, 58, 67, 72, 77, 82, 109, 151, 158, 170, Borough of Manhattan. Bids will also be received for alterations and additions to the electric equipment in Public Schools 20, 25, 31, 40, 56, 79, 160, 188, Borough of Manhattan. Proposals will also be received until July 13 for alterations and additions to the electric bell and electric light systems in Curtis High School and Public Schools 14, 15, 16, 17, 18, Borough of Richmond.

WAVERLY, N. Y.—The Village Trustees are considering making a new contract for street lighting with the Sayre Electric Company, of Sayre, Pa., which calls for replacing a portion of the present arc lamps now used for street lighting with incandescent street lamps. The new contract calls for 11 arc lamps in place of 40 now in use. It is estimated that about 200 incandescent lamps will be used. The cost of the street lamps is about $4,000 per year.

ASHEVILLE, N. C.—The Asheville Electric Company has petitioned for a franchise to operate a street car line on Merrimon Avenue.

GREENSBORO, N. C.—Plans are being made by the Greensboro Electric Company to install a Westinghouse generator of 300 kw to furnish electricity for the street railway service, and a 500-hp Corliss engine. Several months ago the company entered into a contract with the Whitney Power Company, which is erecting a hydro-electric plant on the Yadkin River, by which it was to be supplied with electrical energy after July, 1908, also the exclusive right to distribute electricity from the Whitney plant on the Yadkin River in Guilford County, exclusive of that for the mills of the Proximity Company at White Oak and Proximity. Pending the completion and operation of the Yadkin plant, which was placed in the hands of receivers, the electric company has found it necessary to install additional machinery to meet the demands made upon it.

HENDERSON, N. C.—The Home Telephone & Telegraph Company is planning to extend its system to Jacksonville.

KINGS MOUNTAIN, N. C.—Arrangements are being made to operate the water works pumping station by electricity beginning Aug. 1, which will be furnished by the Southern Power Company, of Charlotte, N. C. The company also supplies electrical energy for operating the municipal electric light system. C. H. Broward is superintendent.

ROCKY MOUNT, N. C.—The Home Telephone & Telegraph Company has recently installed a new common battery exchange in this city and contemplates making other improvements.

BISMARCK, N. D.—The North Dakota Telephone Company contemplates extending its long-distance telephone lines to Brittin, Braddock, Kintyre and Napoleon.

BROCKET, N. D.—The Brocket Farmers' Telephone Company has been granted a franchise to maintain a telephone exchange in Brocket.

CINCINNATI, OHIO.—Bids will be received until July 13 by the Board of Public Service for rewiring and remodeling the electric installation in the buildings of the House of Refuge. John J. Wenner is clerk.

DAYTON, OHIO.—Bids submitted for electrical equipment for the new County Infirmary under the original specifications have been rejected

by the County Commissioners and new proposals will be advertised for under new specifications.

DAYTON, OHIO.—Plans are being made by the Cincinnati, Dayton & Fort Wayne Railway Company to commence work on the construction of its proposed railway in the near future. The railway will extend from Cincinnati to Dayton and to Fort Wayne, a distance of 194 miles. It is proposed to use the third-rail system. Power stations will be located at Seven Mile and Celina, Ohio. S. F. George, of Dayton, is president and general manager.

FREMONT, OHIO.—The Fremont Power & Light Company has been granted a franchise by the City Council to erect transmission lines within the city limits for the distribution of electricity for lamps and motors. This is the company which proposes to develop the water power of the Sandusky River above the town to generate electrical energy.

GALLIPOLIS, OHIO.—Proposals will be received by the Board of Trustees of the Ohio Hospital for Epileptics until July 30 for furnishing material and necessary labor for installation of electrical equipment, to include generator, engine, switchboard, wiring and conduit work, according to plans and specifications on file at the offices of Samuel Hannaford & Sons, architects, Hulbert Block, Cincinnati, Ohio, and 903 Brunson Block, Columbus, Ohio. Proposals must be made out on blanks, which will be furnished on application to the architects or the secretary of the board. William H. Pritchard is secretary.

LIMA, OHIO.—The City Council has sent an ultimatum to W. Kelsey Schoepf, president of the Ohio Electric Railway Company, regarding the renewal of the street lighting contract, demanding a ten-year contract for street lighting with the price of arc lamps at $50 per lamp per year, a maximum charge of 6¼ cents per kw-hour, and a minimum charge of 3½ cents per kw-hour for electricity for commercial lighting, with a permissible discount of 10 per cent on bills; also that the company furnish electricity for lighting all city buildings free. Bids have been opened for the proposed issue of $80,000 in bonds, recently voted by the citizens, for the construction of a municipal electric light plant.

PATASKALA, OHIO.—The capital stock of the Pataskala Telephone Company has been increased from $10,000 to $20,000.

SOMERSET, OHIO.—The Newark Telephone Company has applied to the City Council for a franchise to construct and operate a telephone system in Somerset. If granted a franchise the company will install a plant at a cost of about $20,000. T. J. Smith, of New Lexington; C. E. Hollander, of Newark, and others are interested in the enterprise.

WAYNESBURG, OHIO.—The Bergholtz Telephone Company has been granted a franchise to install a telephone exchange in Waynesburg.

OKEMAH, OKLA.—An election will be held to vote on the proposition to issue $8,000 in bonds for the construction of an electric light plant and water works system.

PERKINS, OKLA.—The Perkins Electric Light & Power Company contemplates establishing a power service and installing a five or ten ton ice plant. I. E. Kenworthy is manager.

SALEM, ORE.—Arrangements have been made whereby the Portland, Eugene & Eastern Railway Company agrees to build an electric railway from Salem to Stayton within one year. The cost of the road is estimated at $300,000, and the business men of Salem and Stayton are to subscribe to $100,000 of this amount. A. Welch is general manager.

PANAMA.—Bids will be received until July 20 at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., for furnishing the following-named articles: Connecting wire, insulating tape, insulating paint, copper, brass, brass and copper tubing, etc. Blanks and general information pertaining to this curcular (No. 452) may be obtained from the the above office, or the office of the assistant purchasing agents, 24 State Street, New York City; Custom House, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.; also from the U. S. engineer offices in the following cities: Seattle, Wash.; Los Angeles, Cal.; Baltimore, Md.; Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Buffalo, N. Y.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; St. Louis, Mo.; Detroit, Mich.; Milwaukee, Wis.; St. Paul, Minn.; Chattanooga, Tenn.; Louisville, Ky.; Mobile, Ala., and Galveston, Tex.; Business Men's League, Kansas City, Mo.; Chamber of Commerce, Quincy, Ill., and Chamber of Commerce and Board of Trade, Tacoma, Wash. Lt.-Col. H. F. Hodges, is general purchasing officer.

PHILADELPHIA, PA.—The City Council has approved the application of the Philadelphia Rapid Transit Company for authority to borrow $5,000,000 to be used for extensions and improvements to its system.

PITTSBURG, PA.—The contract for the construction of the power house at Marshalsea has been awarded by Mayor Guthrie to D. T. Riffle for $26,889.

YORK, PA.—The electrical power service from the plant of the Edison Electric Light Company, furnished by the plant at York Haven, was put into operation July 3 by the York & Windsor Company. This means a day service for both light and power. Full arrangements have not, however, been completed. The storage plant beyond Dallastown and some additional machinery have yet to be placed.

ASHAWAY, R. I.—The contract for the construction of the proposed electric railway from Ashaway to Westerly Road has been awarded by the Ashaway & Westerly Railroad Company to Allen & Phelps. The proposed road will be five miles in length and will be under the management of the Norwich & Westerly Company, which will furnish the rolling stock.

BEAUFORT, S. C.—The citizens on June 29 voted to issue $43,000 in bonds, the proceeds to be used to establish a municipal water works system, electric light plant and building a town hall.

SPARTANBURG, S. C.—The Spartanburg Railway, Gas & Electric Company has decided to extend its street car lines, work on which will commence soon. F. D. McEowen is president and general manager.

FORT MEADE, S. D.—The contract for the electric wiring and fixtures for the new buildings at Fort Meade was awarded to F. E. Newbery & Company, of St. Louis, Mo., for $4,841.

MITCHELL, S. D.—The Mitchell Power Company has purchased a site on which it will erect a new power plant at a cost of about $50,000. The output of the new plant will be more than double that of the old plant. A portion of the machinery in the old plant will be used in the new plant. Improvements will be made to the entire system and the transmission lines will be rebuilt throughout the city.

LEXINGTON, TENN.—The Home Telephone Company has been reorganized under the name of the Henderson County Independent Telephone Company. It is proposed to install a new telephone system in Lexington at once. E. L. Fesmire is president.

LIMESTONE, TENN.—The Trustees of the Bethesda Academy contemplate purchasing an electric light plant. W. T. Morgan is president.

AMARILLO, TEX.—The Panhandle Telegraph & Telephone Company, which was recently incorporated under the laws of the State of Arizona, has been given permission to operate in Texas. The main office of the company will be located at Amarillo. H. H. Davenport, M. C. Lamaster, J. T. Harrison and others are interested in the enterprise.

GRANBURY, TEX.—A. E. Chandler, of Granbury, Tex., has applied for a franchise to build and operate a street railway in Granbury.

BROWNWOOD, TEX.—The City Council has entered into a contract with the Brownwood Gas & Electric Company by which the city will be lighted for six years. Negotiations have been in progress for more than a year, during which time the streets of the city have remained in darkness. A reduction in the price of electricity to private consumers has also been made.

CLEBURNE, TEX.—H. M. Hyatt, of Kansas City, Mo., has been granted a franchise to construct and operate a street railway in Cleburne.

BOYKINS, VA.—The local electric light plant has been purchased by Thomas Atkins and will hereafter be operated under the name of the Boykins Light, Power, Ice & Milling Company. It is proposed to install an ice plant next season.

COLVILLE, WASH.—The plant and holdings of the Northwestern Light & Power Company have been purchased by H. R. Williams, of Spokane. The plant furnishes electricity for lamps and motors in the towns of Colville, Kettle Falls, The Mission and Meyers Falls.

MARBLEMOUNT, WASH.—Plans are being considered by the Skagit Improvement Company for the development of from 75,000 to 100,000 hp from various water privileges its controls. W. R. Morgan, of Sedro-Wooley, is president.

NORTH YAKIMA, WASH.—The Yakima Inter-Valley Electric Railway Company has applied for a franchise to construct and operate an electric railway in Yakima County.

NORTH YAKIMA, WASH.—The North Yakima & East Selah Irrigation Company is planning to build a power canal 13,000 ft. long and develop water power under a 34-ft. head. The power will be used to pump water for irrigation purposes, and the surplus will be used later to generate electricity. Clark O'Bryan, of Seattle, is president of the company.

SEATTLE, WASH.—Bids will be received until July 18 by C. B. Bagley, secretary of Board of Public Works, for the erection of a system of cluster lamps on First Avenue. The cost of the work is estimated at $60,000. R. H. Thomson is city engineer.

SEATTLE, WASH.—The capital stock of the Hanford Irrigation & Power Company has been increased from $250,000 to $750,000, of which $250,000 will be sold immediately, the remainder to be held in the treasury subject to the action of the stockholders at the annual meeting to be held September 21. It is expected that the output of the company's plant at Priest Rapids will be doubled and other extensions and additions made to the system.

ELKINS, W. VA.—Work has commenced on the proposed electric light and power plant of the Valley Improvement Company. R. S. Hunt, of Charleston, W. Va., is engineer in charge of the work.

ATHENS, WIS.—The Capital stock of the Athens Telephone Company has been increased from $6,000 to $10,000, the proceeds to be used for extensions and improvements to its system.

OSHKOSH, WIS.—The property of the Winnebago Traction Company will be sold Aug. 6 at a foreclosure sale. The company operates an interurban railway between Neenah, Oshkosh and Omro.

LANDER, WYO.—A company is reported to have been organized to construct an electric power plant on the Big Popo Agis Canyon. R. G. McDonald, of Hudson, Wyo., is interested in the project.

BOISSEVAIN, MAN., CAN.—The Town Council is considering the question of purchasing the electric lighting plant owned by a private company, but may install a municipal system.

PORTAGE LA PRAIRIE, MAN., CAN.—At a meeting of the City Council it was decided to put a by-law before the people sanctioning the

purchase of the electric lighting plant owned by a private company, the cost of which is estimated at $100,000.

PORTAGE LA PRAIRIE, MAN., CAN.—W. E. Skinner, of Winnepeg, consulting engineer, has submitted a report to the City Council giving the valuation of the plant of the Ceneral Electrical Company, with a view to the purchase of the plant by the city. The report gave the worth of the plant as $42,391, and stated that the additional cost of making the plant up-to-date and increasing the output was estimated at $40,486. A by-law will be voted on July 14 to appropriate $100,000 for the purchase of the plant by the city.

WINNEPEG, MAN., CAN.—The Winnepeg Electric Railway Company has decided to extend its street car line through the town of St. Vital. The company has also applied to the Board of Works for permission to construct a loop on Lombard, Rorie, McDermott and Main Streets. Wilford Phillips is manager.

LISTOWEL, ONT, CAN.—The by-law to appropriate $18,000 for a municipal electric light plant was defeated on June 22.

ST. THOMAS, ONT., CAN.—Plans are being made to extend the St. Thomas Street Railway to Port Stanley, a distance of nine miles.

TORONTO, ONT., CAN.—An electrical engineer is wanted by the city to prepare plans and specifications and supervise the construction of electric plant and distributing system. Applications, with references, etc., for the above position, will be received by James Oliver, mayor, until July 13.

MOOSE JAW, SASK., CAN.—The Canadian General Electric Company, of Montreal, Que., has been awarded the contract for a generating unit for the municipal electric plant, for $36,000.

SAN JUAN BAUTISTA, MEX.—The Compania Tabasquena Electroc-Motrix S. A. has recently placed orders with the Siemens & Halske Company for two producer gas engines of 100 horse-power, direct-connected to two 109-kw dynamos, and for a six-ton ice plant. Roman Romano is president of the company.

New Industrial Companies.

THE CROSS ELECTRIC COMPANY, of Hoboken, N. J., has been chartered with a capital stock of $25,000 by H. Wilkens, C. B. Wilkens and S. Cross. The company is to carry on an electrical and mechanical engineering business.

THE NATIONAL ELECTRIC EQUIPMENT COMPANY, of Boston, Mass., has been incorporated with a capital stock of $50,000. The officers of the company are Charles H. Sprague, president and treasurer, and Everett W. Crawford, clerk, both of Newton, Mass.

THE ELGIN ELECTRICAL MANUFACTURING COMPANY, of Elgin, Ill., has been chartered with a capital stock of $10,000 by M. E. Hepburn, L. B. Hamlin, Jr., and Charles G. Heywood. The company proposes to manufacture electrical supplies and machinery.

THE UNITED ARC LIGHT COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $5,000 and the following directors have been elected: Joseph, Louis and Nathan Koshar, of Brooklyn, N. Y. The company proposes to manufacture gas and electric light fixtures.

THE CORTLANDT ENGINEERING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000. The company proposes to carry on a general electrical contracting business. The incorporators are Le Roy F. Duke, of Bayonne, N. J.; Lester Van Woert, of Alington, N. J.; John Walter Neville, of New York, N. Y.

New Incorporations.

EL CENTRO, CAL.—The Home Telephone Company, of Imperial Valley, has been formed, with a capital stock of $50,000, by Fred Stahl, of Brawley; W. A. Edgar, of Imperial; Fritz Kolke, of Calexico; George Klein, of Heber, and others.

SAN FRANCISCO, CAL.—The Scott Creek Railway Company has been incorporated with a capital stock of $50,000. The directors are J. Downey Harvey, John B. Rogers and B. Corbet.

JOLIET, ILL.—Articles of incorporation will soon be filed for the Gary and Joliet Traction Company, which proposes to build an electric railway connecting Gary, Chicago Heights and Joliet, a distance of 40 miles. The incorporators are W. S. Reed, G. Townsend, J. W. Thomas, of Joliet, and others.

PAYSON, ILL.—The Bluff Hall & Payson Telephone Company has filed articles of incorporation, with a capital stock of $1,050.

MT. VERNON, IND.—The Mt. Vernon Gas & Light Company has been incorporated for the purpose of constructing and equipping a plant to generate and distribute gas and electricity for light, heat and power purposes in Mount Vernon and other towns and cities. The capital stock is $100,000. Fred H. Goodrich, John G. Wester and J. W. Turner are the directors.

CHANUTE, KAN.—The Chanute Electric Railway Company has been organized with a capital stock of $300,000 to construct and operate an electric railway 10 miles long in and around Chanute. The directors are: L. H. Phillips, of Girard, Kan.; S. W. Brewster, H. B. Farrelly and W. D. Kennedy, of Chanute.

LAKE CHARLES, LA.—Articles of incorporation have been filed for the Texas Power Company with a capital stock of $500,000. The company proposes to construct and operate gas and electric plants. It is understood that the main place of business will be in Houston, Tex. The officers of the company are: Charles A. Cleaver, president; Charles S. Cleaver, vice-president, and Rufus Cage, secretary and treasurer.

BOSTON, MASS.—Articles of incorporation have been filed for the Blatchford Light & Power Company with a capital stock of $25,000. The Officers of the company are: Michael T. Moynihan, president; Samuel J. Blatchford, clerk and Bartholemew Moynihan.

PORT HURON, MICH.—The Home Telephone Company is being organized and an application has been made for a franchise in Port Huron. The company proposes to operate telephone systems in St. Clair, Marine City, Algona, Fair Haven, Emmett and other places in St. Clair County. John M. Gleason, George A. Donlin, L. E. Farnum and Frank Gribling are interested in the enterprise.

CLARA CITY, MINN.—The Aheiderland Telephone Company has been incorporated, with a capital stock of $10,000, by I. F. Kray and others. The company proposes to erect and operate rural telephone lines.

KILKENNY, MINN.—The Kilkenny & Cordova Telephone Company has been formed and proposes to install and operate a telephone system in Kilkenny.

AVA, MO.—The Kansas City, Ozark & Southern Railway Company has been incorporated with a capital stock of $300,000 by J. H. Murray, H. E. Bush, J. M. Adams, A. P. Miller and J. S. Clark, all of Ava. The company proposes to build and operate an electric railway system between Mansfield and Ava, a distance of 15 miles.

CHILLICOTHE, MO.—Articles of incorporation have been filed for the Livingston County Mutual Telephone Company, with a capital stock of $15,000.

VIRGINIA CITY, MONT.—Articles of incorporation have been filed for the Caston-Pacific Company with a capital stock of $100,000, and also for the Economic Power Company, capitalized at $200,000. The incorporators of both companies are W. A. Clark, Mary B. Elling, J. H. Paukey, all of Virginia City.

LOUSVILLE, NEB.—The Farmers' Co-operative Telephone Company has been organized by the farmers west of Louisville. It is proposed to install a telephone system at once.

JERSEY CITY, N. J.—The Blaugas Company of America has been incorporated with a capital stock of $5,000.000 by F. Z. Maguire, W. W. Gooch, H. Leiber, K. K. McLaren, F. E. Benedict, F. J. Hastings, W. M. Trinks and F. E. Cash. The company proposes to generate and distribute electricity and gas for light, fuel, heat and motive power.

PAVILION, N. Y.—The Pavilion Telephone Company has been incorporated, with a capital stock of $10,000, by B. J. Berad, of Pavilion, N. Y.; G. D. Dean Hudson and Horace S. Bradley, of Wyoming, N. Y., and others.

WOOSTER, OHIO.—The Wayne County Telephone Company has been organized, with a capital stock of $10,000, to install a telephone system in Wooster and Orrville.

BIGHEART, OKLA.—Articles of incorporation have been filed for the Bigheart Telephone Company by D. J. Dunham, J. L. Cosden, J. D. Mandeville, E. T. Gibson and others.

ANNVILLE, PA.—The North Annville Rural Telephone Company has been organized and the following-named officers elected: Cyrus Boger, president; J. A. Long, secretary, and S. W. Heilman, treasurer. The company has erected about eight miles of telephone line and is planning to extend its system to McGillstown and other points and establish connections with the American Union Telephone Company at Annville.

MILLWAY, PA.—The Millway & Rothsville Rural Route Telephone Company has been organized and proposes to operate telephone lines in Ephrata, Lititz, Millway and other places. H. Walters, of Rothsville, is to be general manager of the company.

HURON, S. D.—The Aberdeen-Huron Railway Company has been incorporated with a capital stock of $2,500,000, to construct an electric railway from Huron to Aberdeen, a distance of 80 miles. The incorporators are John A. Cleaver, R. W. Clarke, L. Lapier, J. P. Stahl, G. W. Longstaff, Oscar A. Ricker, R. D. Whorton, R. C. Gibbs and H. J. Rice, all of Huron, S. D.

KIMBALL, S. D.—The Cleveland Smith Telephone Company has been incorporated for the purpose of erecting and operating rural telephone lines throughout Brule County with headquarters in Kimball. The company is capitalized at $5,000, and the incorporators are A. L. Carey, P. D. Brady, B. Ryann and others.

DUCKTOWN, TENN.—The Mine City Telephone Company has been incorporated to erect and maintain a telephone system at Ducktown and throughout Polk County. The company is capitalized at $500 and the incorporators are J. M. Kilpatrick, Carl Center, C. M. Campbell, W. S. Love and W. I. Morris.

McMINNVILLE, TENN.—The Citizens' Telephone Company, of McMinnville, has been incorporated, with a capital stock of $5,000, by James Walling, Butler Smith, J. M. Lively, A. H. Faulkner and J. J. Morford.

VIOLA, TENN.—The Viola Telephone Company has been organized, with a capital stock of $5,000, and the following officers: E. W. Smith, president; Frank P. Blue, vice-president; Lionel D. Ramsey, secretary and treasurer and general manager.

CISCO, TEX.—The Cisco Light & Power Company has been chartered with a capital stock of $16,000 by G. W. Troxell, W. C. Bedford and others.

PROSSER, WASH.—The Benton Independent Telephone Company has been organized and the following directors elected: I. W. Carter, T. J. Stockdale, J. H. Hoagland, C. E. DeBow, R. H. Bone, J. T. Jackson, D. T. Smith and George C. Lincoln.

BEAVER DAM, WIS.—Articles of incorporation have been filed for the Beaver Dam Fuel & Light Company. The company is capitalized at $85,000 and the incorporators are: F. N. Pettigrew, Henry Dickson, H. A. Graham and W. C. North.

CAMPBELLSPORT, WIS.—The Campbellsport Electric Light & Power Company has been incorporated with a capital stock of $10,000 by John F. Sharp, Richard A. Sharp and M. H. Brand.

INDEPENDENCE, WIS.—The Independence Telephone Company has been chartered with a capital stock of $8,000 by C. H. Short, Frank Wise, F. C. Cripps, A. J. Bautch, B. Brethauer and others.

MALLORYTOWN, ONT., CAN.—Articles of incorporation have been filed for the Mallorytown Independent Telephone Company by C. E. Tennant, E. I. Mallory and A. H. Judson.

MOLESWORTH, ONT., CAN.—The Molesworth Telephone Company has been organized and has erected a telephone line to Listowel. The company will erect additional telephone lines.

TILBURY, ONT., CAN.—The Farmers' Consolidated Telephone Company has been organized to operate telephone lines in Essex and Kent Counties. The directors are W. C. Crawford, J. S. Richardson, Dr. Knister and H. J. Beuglet.

Obituary.

MR. THOMAS F. ATTIX, president of the T. F. Attix Electrical Engineering Company, of Brooklyn, N. Y., died July 4. Mr. Attix was born in Seneca County, N. Y., in 1830, and had been a resident of Brooklyn for about 35 years. He was engaged in electrical engineering business for about 26 years. He was a charter member and prominent in the affairs of the Building Trades Employers' Association of New York, and of the National Electric Light Association. He is survived by two sons, Thomas F., Jr., and Albert A., both residents of Brooklyn.

Personal.

MR. GEO. LORING, who has been with the engineering department of the National Electric Lamp Association, on July 1, returned to the Shelby Electric Company, with which he has been associated for many years.

MR. BION J. ARNOLD has been appointed by the Public Service Commission of Greater New York an expert to appraise the value of the surface railways of Manhattan Island, in order to determine the contention of the receivers that they cannot carry out the improvements ordered because of lack of funds.

Trade Publications.

ELECTRICAL FITTINGS.—The Advance Mfg. Co., Pittsburgh, Pa., has just isued a catalogue of electrical and mechanical fittings, appliances and machines. Among the electrical ăttings included are a line of circuit fittings, water-protected sockets, weight electrical and cord adjusters, short indoor and outdoor fixtures, adjustable shade holders, etc.

STORAGE BATTERY RHEOSTATS.—The Ward Leonard Electric Company, of Bronxville, N. Y., has issued a new catalogue, covering battery-charging rheostats for electric automobiles for private plant and garage duty; also rheostats to take care of the discharge of storage cells, and a complete line of charging rheostats for ignition cells and portable batteries.

THE CENTRAL ELECTRIC COMPANY, Chicago, are distributing a booklet entitled "A Few Suggestions on Methods of Constructing Telephone Drop Circuits" and also calling special attention to their "Universal" porcelain insulators for this purpose. A considerable number of illustrations are employed, showing the various methods of attaching the insulators to cross arms, poles and walls.

GREEN FUEL ECONOMIZER PUBLICATIONS.—The Green Fuel Economizer Company, Matteawan, New York, is sending out a descriptive list of all of its publications, accompanied by a postal card to be returned by those who desire to receive one or more of the publications which they may designate. The list includes 11 items, relating to the Green economizer, waste-heat air heaters, fans, blowers, exhausters, mechanical draft, heating and ventilation, etc.

THE CENTRAL ELECTRIC COMPANY, Chicago, are distributing a folder, entitled "Daylight at Night," describing the Columbia tungsten lamps, for which they are general Western sales agents, and giving prominence to the fact that immediate deliveries on these lamps can be given from their Chicago warehouse. Considerable data are given as to the watt consumption compared with carbon filament lamps, this comparison being worked out on the basis of both 5 cents and 10 cents per kilowatt hour.

RAILWAY CONVERTER SUBSTATIONS.—The General Electric Company, Schenectady, N. Y., has just issued Bulletin No. 4593, devoted to the subject of "Railway Converter Substations," giving a general description of the various pieces of substation apparatus, including rotary converter transformers, reactances, blowers, cables, switchboards, etc. It includes illustrations of converter stations operated by various well-known railway companies, and contains also plans and elevations showing different arrangements of substation apparatus.

INTERCOMMUNICATING TELEPHONE EQUIPMENTS. — The Western Electric Company, 463 West Street, New York City, has recently issued a very attractive series of publications relating to their intercommunicating telephone equipments for factories, department stores, offices, residences, hotels and public buildings. The time-saving feature of an intercommunicating system for business men is treated of in one booklet and the convenience of the system for residence use is attractively illustrated and described in another. Two other booklets are devoted respectively to the key-operated and the jack-operated types of sets, information being given regarding the different kinds of service for which the sets are adapted and their operation. The fifth book of the series is a 38-page, 8-in. by 10-in. publication intended for the installer or contractor. This book gives instructions for installing and wiring up the equipments, lists the apparatus and supplies and describes the best methods of using them.

SELF-STARTING DEVICES FOR ALTERNATING MOTORS.—Automatic starting is often necessary to the economical operation of induction motors. Devices for the automatic control of such motors described in Bulletin No. 4590, just issued by the General Electric Company, Schenectady, N. Y., are designed for the remote or automatic operation of Form K induction motors, or other motors of the squirrel-cage type in sizes of 5 hp and larger. They consist of two main oil-immersed switches operated by solenoids, which are excited from one phase of the current supply. With the closing of the exciting circuit of the solenoids one of the main switches automatically connects the motor to the line through the compensator coils, and an adjustable time relay opens the first main switch at the proper time, cutting the compensator coils out of circuit and closing the second main switch, thus throwing the motor directly on the line. The switches are so arranged as to be easily inspected, and the entire device is mounted on a slate panel having pipe supports, which hold it at a convenient height. The same publication describes an automatic control equipment for use in connection with the General Electric Form M three-phase induction motors, the principal use of which is in maintaining a predetermined air pressure, water pressure or water level, by automatically starting and stopping motor-driven pumps in the supply mains. A full description of this equipment, as well as the automatic compensator, are given in the bulletin.

Unclassified Items.

(Items received too late to classify under Construction News, etc.)

HAMILTON, ONT., CAN.—The Cataract Power Company has submitted a proposition to the City Council offering to furnish electricity for lighting the streets, public buildings and for pumping the city water supply for a term of 20 years, in five-year option terms, the price for the service to be fixed by arbitrators appointed by the city. Assuming the City Council will accept the proposition of the Cataract Power Company, the special committee appointed to draft a form of contract has decided to engage Mr. Abbott, of the Abbott-Robertson Company, of Cleveland, Ohio, to advise which is the best of the company's propositions and to protect the city's interests.

KAYSVILLE, UTAH.—The local electric light plant installed by B. E. Slusser, has been purchased by the City Council. It is proposed to extend the transmission lines and light the business and residence districts.

BUFFALO, N. Y.—Mayor Adams has vetoed the resolution passed by the Board of Aldermen appropriating $5,000 to pay half of the expenses for an investigation of the prices charged for electricity in this city by the Buffalo General Electric Company before the Public Service Commission. The Mayor states that he is not opposed to an investigation, but thinks that if the city is to make a complaint it should bear all the expense, and should not be hindered by an expense limit.

SOUTHAMPTON, N. Y.—The Town Board is considering the question of creating a lighting district at Water Mill and Mecox.

GUANAJUATO, MEX.—The Guanajuato Consolidated Mining & Smelting Company is installing a 200-kw rotary converter in the Sirena Mine, which will supply direct current to the motors in and about the mine and to operate the electric locomotives. Electric energy for operating the machinery is furnished by the Guanajuato Power Company.

CHARLOTTE, N. C.—The Sargent Manufacturing Company is planning the erection of a plant to manufacture cotton yarns in this city, which will have a capacity of 3000 spindles. The plant will be operated by electricity. Sumner B. Sargent is secretary and treasurer.

TACOMA, WASH.—With a view of developng the water power of American Lake, Lucian F. Cook has filed with the county auditor a claim to water rights in the lake. It is proposed to carry the water from the west side of the lake to the waterfront by means of a flume, a distance of four miles, where a power plant will be erectetd to generate electricity. It is claimed that a fall of 200 ft. would be secured, capable of developing from 1000 to 3000 hp.

GREGORY, S. D.—A franchise has been granted to Fred. Largen, of Creighton, to install an electric light plant in Gregory.

BOSTON, MASS.—The Edison Electric Illuminating Company has submitted a proposition to the city to furnish incandescent electric lamps in certain streets, parks and alleys in the city. The company offers to furnish incandescent lamps of 40 and 60 cp, respectively, with an all-night service, as follows: 40-cp lamps at $20.37 each per year, and 60-cp lamps at $23.49 per lamp per year, subject to a discount in both cases of 5 per cent on a five-year contract, which would reduce the prices to $19.35 and $22.32, respectively. At present the company states it would not wish to supply the lamps except where locations can be reached by overhead wires, or such extensions as can be made without unreasonable expense, while ultimately they may be placed in any location desired.

GUADALAJARA, MEX.—The Boca Ancha Mining Company is planning to construct a hydro-electric plant to furnish electricity for mining and milling purposes.

PAWTUCKET, R. I.—The J. & P. Coats Thread Mills have substituted electricity for steam power to operate its mills. The electric plant was completed and placed in operation July 6, and is now furnishing electrical energy for operating the entire plant.

CANNON FALLS, MINN.—The Cannon Falls Electric Service Company will furnish electricity for commercial purposes and deal in electric signs and specialties, electric fixtures and shades. The owners of the plant are E. L. Twiss, D. E. Twiss and L. F. Blinco.

KIRKSVILLE, MO.—The Kirksville Light, Power & Ice Company has taken over the electric light and power plant of the Kirksville Electric Company, and is building an ice plant, which is expected to be in operation within 60 days. Charles V. Miller is president, and C. J. Baxter secretary.

ATHENS, GA.—The Athens Electric Railway Company is increasing the equipment of its power house by the installation of a 1000-kw Allis-Chalmers turbo-generator set, with Worthington condensers and an additional battery of Sterling water tube boilers.

LODI, WIS.—Plans are being considered to install an additional 100-hp boiler in the municipal electric light plant.

OLATHE, KAN.—The management of the local electric light plant is being reorganized and the capital stock increased to $20,000. New machinery will be installed and a 24-hour service will be established. B. C. Morrison is manager.

HILLSBORO, KAN.—Plans are being considered by J. W. Buller, of this city, for the construction of an electric light plant in Hillsboro this fall, the cost of which is estimated at $6,000.

WILKES-BARRE, PA.—Bids will be received until July 20 by James M. Norris, county controller, for a motor generator set and stationary transformer equipment to be installed in connection with the electrical distributing system in the Luzerne County Court House. McCormick & French, Second National Bank Building, Wilkes-Barre, are the architects.

ESCANABA, MICH.—The power plant of the Escanaba Electric Pulp & Power Company, which is now under construction near Escanaba, will have an output of 750 kw and will furnish electricity for operating the municipal electric light plant and the street railway system of Escanaba, contracts for which have already been placed. The officers of the company are: O. L. Huie, president; J. F. Malloy, vice-president; P. L. Utley, secretary and treasurer.

UNIVERSITY, MISS.—The contract for the construction of the electric power house and steam heating plant at Oxford, Miss., has been awarded to the Benjamin F. Barbour Plumbing & Electric Company, of Birmingham, Ala., for about $33,000. F. G. Prout, of Memphis, Tenn., is engineer.

ALAMEDA, CAL.—The Southern Pacific Railroad Company has notified the Mayor that it will soon commence the work of equipping its local railways to be operated by electricity and accept one of the two propositions offered by the City Council.

FAIRFAX, S. D.—C. A. Johnson is reported to have made arrangements with the Fairfax Milling Company, whereby the company will install an electric generator in its mill to be operated in connection with the gas engine. The electric equipment will have an output of about 1000 lamps.

LAUREL, MONT.—It is proposed to have the town lighted by electricity, the service to be furnished by the Billings & Eastern Montana Power Company.

COLORADO SPRINGS, COL.—Work will soon commence on the construction of the new substation of the Colorado Springs Electric Company on West Cucharas Street.

BUFFALO, N. Y.—The contract between the city and the Buffalo General Electric Company to furnish electricity to operate the two pumps at the pumping station at Massachusetts Avenue expired June 30, and as yet the contract has not been renewed. The company has agreed to continue the service until further arrangements have been made. The city pays at the rate of $25 per hp, making the cost about $7,000 per month.

BEAVER, PA.—It is understood that arrangements have been made for financing the proposed electric railway between Beaver and Ellwood City, and that work on the construction of the road will commence this summer. The railway will be eight miles in length. H. W. Hartman is interested in the enterprise.

SOMERSET, PA.—Work has commenced on the construction of the Pennsylvania & Maryland Street Railway from Meyersdale to Garrett.

HARRISBURG, PA.—Governor Stuart has approved of the consolidation of eight electric railways in Western Pennsylvania under the name of the Suburban Railway Company, with a capital stock of $150,000. The main office of the company is to be at Rochester, Pa. The names of the consolidated companies are as follows: The Suburban Company, the Freedom & Baden Electric Street Railway Company, the Sewickley & Leetsdale Electric Street Railway Company, the Beaver Falls Electric Street Railway Company, the Beaver & Bridgewater Electric Street Railway Company, the Rochester, Beaver & Vanport Electric Street Railway Company, New Brighton, Beaver Falls & Marado Electric Street Railway Company, and Economy & Harmony Electric Street Railway Company. W. A. Park, of Rochester, will be president of the company.

REDDING, CAL.—H. A. Telford, acting for the Northern California Power Company, has filed two notices of appropriation of water rights, one for 3000 in. of the waters of Bailey Creek and the other for 5000 in. of water of North Battle Creek.

GUYMON, OKLA.—Articles of incorporation have been filed for the Guymon Electric Light & Power Company by J. H. Wright, R. S. Cox and S. B. Hale. The company is capitalized at $40,000.

WILLOWS, CAL.—At the annual meeting of the Snow Mountain Power Company the following named officers were elected: C. H. Glenn, of Fouts Springs, president; B. H. Burton, of Colusa, vice-president; C. R. Wickes, of Willows, secretary and treasurer. It is said that the company will begin work on the construction of its plant in August and expects to have it completed this season. The company will furnish electricity throughout the valley.

WATERVLIET, N. Y.—The General Electric Company is installing an electric railway at the Watervliet Arsenal, to supersede the old one which has been used to haul the heavy guns and other material to the river dock.

BELOIT, WIS.—The Beloit Water, Gas & Electric Company has made a voluntary surrender of all its franchises and will operate under the indeterminate franchise act. The Council has ordered an investigation by the State Railroad Commission to determine the equity of the present rates.

Business Note.

CUTLER-HAMMER IN SAN FRANCISCO.—Announcement is made that the Cutler-Hammer Manufacturing Company, of Milwaukee, makers of electric controlling devices, has just completed arrangements whereby this firm will be represented on the Pacific Coast by Otis & Squires, of 111 New Montgomery Street, San Francisco. A large stock of standard Cutler-Hammer controllers will be carried by Otis & Squires, enabling them to make prompt delivery of apparatus. Mr. A. W. Vinson, who has for several years been connected with the engineering department of the Cutler-Hammer Manufacturing Company, has been transferred to the office of Otis & Squires, where his services will be available to those confronted with problems of electric control, which cannot be met by the use of standard apparatus.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 30, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

891,825. ELECTRIC WIRE SPLICER; Conrad J. Dorff, Chicago, Ill., App. filed June 27, 1907. Makes use of a sheet metal clip of S-shaped cross section and which is twisted to a spiral form after the conductors have been placed therein.

891,833. OIL SWITCH; Edward M. Gerry, Norwood, Ohio, App. filed May 10, 1905. An oil switch or circuit-breaker particularly adapted for use in connection with high-voltage systems and designed to reduce the current in the circuit to a comparatively small amount before the final break. Has a resistance element included in the mechanism of the switch and submerged in the oil bath.

891,834. CONTROLLER OPERATING MEANS; Thomas Gilmore, Jr., Norwood, Ohio, App. filed Nov. 3, 1906. The controller handle has a detent which swings into position to prevent the controller from being moved through its range of movement without an intermediate pause at each notch, during which the detent is released.

891,847. DYNAMO ELECTRIC MACHINE; Emil Mattman, Norwood, Ohio, App. filed Aug. 31, 1906. Provides means by which the cross connectors of the brush holders are spaced apart and clamped rigidly in position, so that sufficient insulating distance is provided, and there is no danger of the cross connectors being distorted or seriously vibrated.

891,860. DEVICE FOR SECURING BOND WIRES TO A RAIL JOINT; Welles M. Post, Wilkinsburg Borough, Pa., App. filed Sept. 12, 1907. The patentee has a small metallic clip which is fastened to the web of the rail by the usual bolts of the fish plates, and which supports the bond rails.

891,893. CIRCUIT CONTROLLING MECHANISM; George M. Willis, Chicago, Ill., app filed Aug. 29, 1906. A burglar alarm device comprising metallic pins which are adapted to be received in small mercury cups stamped from sheet metal and fastened to the window or door to be protected.

891,898. PROCESS OF MAKING LOW-CARBON METALS OR ALLOYS; Frederick M. Becket, Niagara Falls, N. Y. App. filed Aug. 24, 1905. A process of producing low-carbon metals, which consists in producing under electric furnace conditions a metallic product

low in carbon and high in silicon, and then oxidizing part or all of the silicon.

891,906. ARMATURE CORE; John F. Card, Three Rivers, Mich. App. filed Mar. 16, 1907. Construction of core for a dynamo electric machine, having transverse and longitudinally extending passages for the purpose of ventilation. Makes use of specially constructed sheet metal spacers for the laminations.

891,947. AUTOMATIC CAR BRAKE; James Harry Keighly McCollum, Toronto, Ont., Can. App. filed Nov. 17, 1906. An automatic mechanism for applying brakes whenever the current of the motors is cut off at the controller.

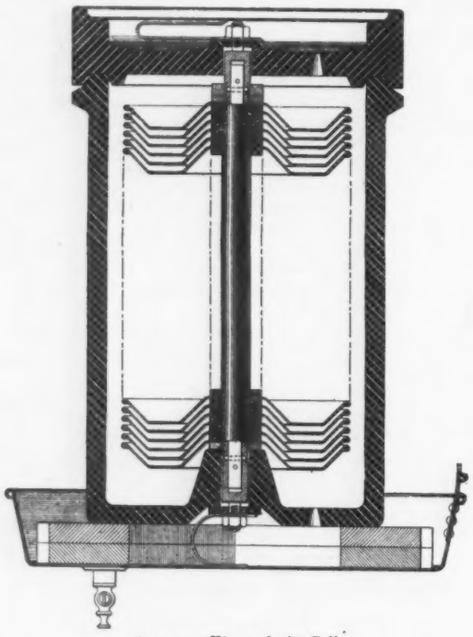
891,948. ELECTRIC FIRE ALARM AND THERMO INDICATOR; Alfred Henry McNeil, of Highams Park, Eng. App. filed Nov. 11, 1907. A thermal circuit closer for fire alarm systems having a bent thermal element rigidly supported between two abutments and adapted to displace a pair of contact springs into engagement.

891,955. INSULATOR; William C. Sandlin, of Andrews, N. C. App. filed Sept. 25, 1905. In the place of the usual insulator, the patentee makes use of a flat base with a pair of studs between which the wire is twisted in a sinuous path.

891,961. TELEPHONE CONTROLLING DEVICE; Nathan Silverson, New York, N. Y. App. filed Nov. 2, 1906. Construction of telephone having means for preventing its use by unauthorized persons, but enabling incoming calls to be received, although the telephone is locked against use for transmission.

891,982. ELECTROLYTIC PROCESS FOR THE PRODUCTION OF METALLIC DARK COATINGS UPON METALS; Alexander Classen, Aachen, Germany. App. filed Sept. 3, 1907. An electrolytic process for making a metallic deposit of dark color by which the tension of the current is considerably reduced after a bright metallic luster has been produced.

891,995. ELECTROLYTIC CELL; Ralph B. Ingram, Wilkinsburg, Pa.



891,995—Electrolytic Cell.

App filed Oct. 24, 1906. Electrolytic cell of the tray-plate type for use in connection with lightning arresters in which the well-known electrolytic valve action is produced.

892,016. TROLLEY WHEEL; Robert P. Stark and Charles R. Klingensmith, Creighton, Pa. App. filed Apr. 23, 1907. A built-up trolley wheel having removable tread and flanged portions, and having a central hub with a spiral groove for the distribution of oil.

892,060. DISCONNECTING DEVICE FOR TELEPHONE LINES; Frederick Johnson and Harry Smith, Hatfield, Mo. App. filed March 27, 1907. In a device of the character described, a main line connected to a post by insulators, a contact lever pivoted on the post and provided with a contact head adapted to engage the wire at some distance from the post, a house wire connected to said contact lever and extending to the instrument within the house, a spring for holding said contact lever in operative position, and a cord connected to said lever and extending through the wall of the house for throwing said contact lever out of contact with the line wire.

892,065. ELECTROMAGNET; David L. Lindquist, Yonkers, N. Y. App. filed June 14, 1905. Has a spring for equilibrating the attraction of the magnet upon its armature and for taking up the vibrations of the armature due to current variations in the winding.

892,158. RELAY FOR BURGLAR ALARM SYSTEMS; Ole Jacobson, Chicago, Ill. App. filed Nov. 8, 1907. Relates to a relay for a closed circuit local burglar alarm system. Has means by which the alarm bell may be started ringing and kept ringing until stopped by the closure of the main circuit—all accomplished by a single relay.

892,167. MOUNTING FOR ELECTRICAL APPARATUS; Malcolm E. Launbranch, Chicago, Ill. App. filed Dec. 7, 1904. A magneto generator is mounted in an enclosing casing so as to be removable, but it is adapted to be located in place within the casing when desired.

892,177. ELECTRIC ILLUMINATOR; Henry J. Mullen, Burlington, Vt. App filed Sept. 22, 1905. Electric illuminator in which the means for controlling the currents to the lamps is in the form of a rotatable cylinder which is adapted to be removed and the wiring changed to produce new sign combinations.

892,188. PROCESS FOR SEPARATING AND SIMULTANEOUSLY EXTRACTING WATER FROM MINERAL, VEGETABLE AND ANIMAL SUBSTANCES; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed Apr. 30, 1907. Consists in causing the suspended solid particles to be deposited fractionally.

892,203. SIGNALING SYSTEM FOR RAILROADS; Max W. Zabel, Chicago, Ill. App. filed Apr. 13, 1907. Railroad signaling system having means whereby any block in a despatcher's division may receive a selective signal to the exclusion of all other blocks, and whereby a positive indication is given to the despatcher that the selective signal is received.

892,204. RAILWAY SIGNALING APPARATUS; Max W. Zabel, Chicago, Ill. App. filed April 13, 1907. Relates to modifications of the above.

892,211. PROCESS OF PRODUCING LOW CARBON ALLOYS; Frederick M. Becket, Niagara Falls, N. Y. App. filed Jan. 8, 1908. Process by means of which alloys of the refractory metals, and more particularly vanadium and tungsten, may be obtained with a low carbon content and with any desired proportion of iron or other alloying metal.

892,212. ELECTRIC FURNACE METHOD; Frederick M. Becket, Niagara Falls, N. Y. App. filed Jan. 8, 1908. Relates to apparatus for carrying out the method of the foregoing patent.

892,220. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; James F. Burns, Philadelphia, Pa. App. filed Sept. 28, 1907. An outlet box of rectilinear outline having rounded corners and a removable portion at one corner fastened in place by a pair of machine screws so as to cover a greater or less number of the outlet openings, as desired.

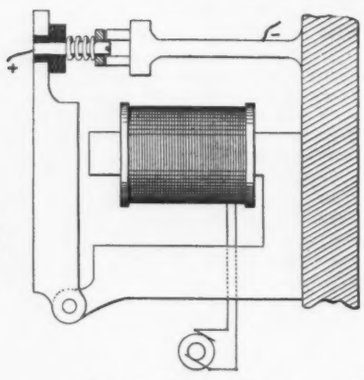
892,241. METHOD OF ELECTRICALLY DETECTING DANGEROUS GASES AND APPARATUS THEREFOR; Henrich Freise, Bochum, Germany. App. filed June 10, 1907. Consists in passing the dangerous gas across rays of light projected from a source of light to a selenium cell.

892,272. TROLLEY GUARD AND GUIDE; Charles Latach, Cleveland, Ohio. App. filed Sept. 3, 1907. The trolley harp has a pair of laterally swinging arms pivoted thereto with rounded rollers at their upper ends adapted to close over the trolley wheel.

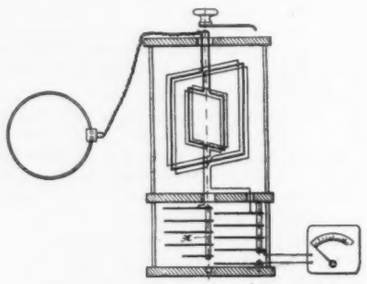
892,279. DROP TROLLEY; Thomas H. Mars, Chicago, Ill. App. filed Oct. 5, 1906. A trolley retriever of the type having a special trip connection for supporting the pole which is released in cases of sudden or abrupt movement. Is designed to prevent the pole from rebounding after it falls.

892,311. APPARATUS FOR PLOTTING RESONANCE CURVES; Otto Scheller, Steglitz, near Berlin, Germany. App. filed March 9, 1908. Provides an apparatus for plotting resonance curves, making use of a self-induction variometer and a variable condenser, which are given equal and concurrent movements.

892,312. SYSTEM FOR RECEIVING UNDAMPED ELECTRIC OSCILLATIONS; Otto Scheller, Steglitz, near Berlin, Germany. App. filed March 9, 1908. A receiving system for wireless telephony comprising



892,065—Electromagnet.



892,311—Apparatus for Plotting Resonance Curves.

a resonant receiving circuit, a resonant indicator or detector circuit associated therewith, and electrical connections between said circuits, including an interrupter and a rectifier.

892,319. BINDING POST; Nicholas Sohl, New York, N. Y. App. filed May 28, 1907. A binding post making use of a U-shaped spring clip with laterally extending lugs having perforations to receive a conductor which is engaged by the outer prong of the clip.

892,332. ELECTRICAL INCANDESCENT LAMP; Orlando M. Thowless, Newark, N. J. App. filed Oct. 26, 1906. An improved glower for electrical incandescent lamps, comprising a refractory non-conductive core having thereon a continuous coating of homeogeneous refractory metal.

892,355. TROLLEY WHEEL; George C. Bourdereaux, Peoria, Ill. App. filed Aug. 29, 1906. Includes a trolley fork in two sections suitably connected together and which may be removed from the trolley arm without becoming separated.

892,359. ELECTRIC RAILWAY SIGNALING SYSTEM; Yorke Burgess, Washington, D. C. App. filed Sept. 24, 1907. Has signal means on each train, a pair of traveling contacts on each train, and a plurality of conductors each arranged to be alternately in the path of both contacts.

892,360. ELECTRIC INSOLE; William Henry Burns, Naperville, Ill. App. filed July 11, 1907. Makes use of zinc and copper plates stamped with perforations of such a character that the perforations of one overlie the metallic portions of the other.

892,371. TROLLEY EAR; Charles W. Eliot, Tampa, Fla. App. filed April 9, 1906. A means whereby a trolley ear is prevented from becoming detached from its fastening or support by reason of vibrations of the trolley wire due to the operations of the trolleys therealong or from other cause. Has a screw fastening with a cotter pin.

892,375. ELECTRIC SOCKET SWITCH; Harvey Hubbell, Bridgeport, Conn. App. filed June 7, 1907. Details of socket switch having a spindle with a sheet metal cam engaged by a detent roller.

892,378. METHOD OF TREATING COLD CRUDE PETROLEUM OR DISTILLATE THEREOF TO OBTAIN AN EXPLOSIVE MIXTURE FOR INTERNAL COMBUSTION ENGINES; Dan Martini, London, Eng. App. filed June 10, 1907. Consists in ironizing petroleum in the form of a mist, spray, or vapor by mixing it with an ironized gas containing oxygen.